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(54) BOARD FOR MAGNETIC RECORDING MEDIUM

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a board for a magnetic recording medium in which minute recesses and projections can be stably formed without asperity, the height of projections is made almost uniform and recorded information can be stably read out.

SOLUTION: The substrate 11 of a substrate 10 for a magnetic recording medium has minute recesses and projections which result in 0.4 to 3.0 nm average surface roughness Ra and ≤14 ratio of the ten-point average roughness (Rz) to the average surface roughness (Ra). When the projections are cut along a plane parallel to the board surface at the position of specified depth from the peak of the highest projection in a specified region, the sum area of the cross sections of the projections in the cut plane is represented by X% to the area of the specified region of the board surface and the depth is represented by Z (X%). The ratio of Z (1%) to the referential value {Z (50%)-Z (1%)} is specified to ≤3.

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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

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CLAIMS

[Claim(s)]

[Claim 1] The minute irregularity which has a projection group is formed in a substrate front face, and it is the range whose average side granularity on the front face of a substrate (Ra) is 0.4-3.0nm. The ratio of the ten-point average side granularity (Rz) on the front face of a substrate to the average side granularity on the front face of a substrate (Ra) is 14 or less. And when a projection group is cut from the top-most vertices of the highest projection in a predetermined field in respect of being parallel to the substrate front face in the location of the predetermined depth, The substrate for magnetic-recording media which formed the minute irregularity whose ratio of Z (1%) to a reference value {Z(50%)-Z (1%)} is three or less on the surface of the substrate when the depth in case the value which totaled the area of the cutting plane of each projection within the field becomes X% of the area of the predetermined field on the front face of a substrate was set to Z (X %).

[Claim 2] The substrate for magnetic-recording media according to claim 1 characterized by said substrate consisting of non-magnetic materials, such as glass, glass ceramics, ceramics, and aluminum.

[Claim 3] Said substrate is a substrate for magnetic-recording media according to claim 1 characterized by having ferrimagnetism or ferromagnetism.

[Claim 4] Said substrate is a substrate for magnetic-recording media given in either of claim 1 to claims 3 which have the data area where information is recorded on the front face, and formed said minute irregularity in the data area at least.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] It is related with the substrate for magnetic-recording media used for magnetic-recording media, such as an information recording apparatus, especially a hard disk drive unit. It is related with the substrate for magnetic-recording media used for the hard disk drive unit which has various heads, such as the so-called CSS, ramped loading, and a contact method, a disk, and an interface in more detail.
[0002]
[Description of the Prior Art] In order to raise the consistency of magnetic recording, preventing generating of adhesion of the magnetic head and a magnetic disk in the hard disk drive unit of the type with which the magnetic head surfaces at the time of actuation like CSS or ramped loading, and the hard disk drive unit with which the magnetic head is called the contact method which always touches the front face of a magnetic disk at the time of actuation and a halt, it has been necessary to form irregularity (for it to be about 0.4 to 3nm at surface roughness Ra) still minuter than before in a magnetic-disk front face.
[0003] The technique which forms such minuter irregularity in the substrate front face which consists of inorganic materials, such as glass, by etching processing is examined partly in the past. For example, in JP,5-314456,A, the technique which forms irregularity is indicated by etching a glass substrate with the mixed solution of fluoric acid and a potassium fluoride.
[0004]
[Problem(s) to be Solved by the Invention] However, according to these conventional techniques, the average irregularity formed has this invention persons quite larger than average target minute irregularity. Then, although this invention persons examined target minute irregularity according to etching conditions other than said conventional technique by re-evaluating etching conditions, there was a case where excelled rather than the height of the average projection called asperity, and it generated discretely [a high projection] or selectively. Moreover, even if it was the case where a projection high like it calls it asperity did not exist, there was a case where the height of each projection became an ununiformity.
[0005] And when the projection with uneven minute irregularity which has asperity or its height produced a magnetic disk using the glass substrate formed in the front face, there was a problem of causing a head crash, or generating a noise when reading the information recorded on the magnetic disk.
[0006] Furthermore, the configuration of INTAFEISU between heads, such as a head which has the head at the time of the storing approach of a head like ramped loading and a contact method and the head at the time of a hard disk drive unit halt between disks or hard disk drive unit actuation, the existence of contact of a disk and various slider configurations, and floatation and a transit property in recent years in addition to CSS, a disk, and a head and a disk is being diversified.
[0007] Since the design of each head, a disk, and an interface changes with manufacturers who assemble a hard disk drive unit, this is considered to have suggested that the granularity on the front face of a magnetic disk needed and the height of a projection change delicately with each assembly manufacturers. So, as for the granularity of the minute irregularity formed in a substrate front face, and the height of a projection, it is desirable that it is controllable to delicacy and accuracy.
[0008] This invention is made paying attention to the trouble which exists in the above conventional techniques. The place made into the object can arrange the height of a projection so that it may become almost uniform, and is to offer the substrate for magnetic-recording media which is stabilized and can read the recorded information while being stabilized and being able to form minute irregularity without asperity.
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned object, invention of the substrate for magnetic-recording media according to claim 1 The minute irregularity which has a projection group is formed in a substrate front face, and it is the range whose average side granularity on the front face of a substrate (Ra) is 0.4-3.0nm. The ratio of the ten-point average side granularity (Rz) on the front face of a substrate to the average side granularity on the front face of a substrate (Ra) is 14 or less. And when a projection group is cut from the top-most vertices of the highest projection in a predetermined field in respect of being parallel to the substrate front face in the location of the predetermined depth, When the depth in case the value which totaled the area of the cutting plane of each projection within the field becomes X% of the area of the predetermined field on the front face of a substrate is set to Z (X %), the ratio of Z (1%) to a reference value {Z(50%)-Z (1%)} forms the minute irregularity which is three or less on the surface of a substrate.
[0010] Invention of the substrate for magnetic-recording media according to claim 2 is characterized by said substrate consisting of non-magnetic materials, such as glass, glass ceramics, ceramics, and aluminum, in invention according to claim 1.
[0011] As for said substrate, invention of the substrate for magnetic-recording media according to claim 3 is characterized by having ferrimagnetism or ferromagnetism in invention according to claim 1. Said substrate has the data area where, as for invention of the substrate for magnetic-recording media according to claim 4, information is recorded on the front face in invention given in either of claim 1 to claims 3, and forms said minute irregularity in a data area at least.
[0012]
[Embodiment of the Invention] Below, the operation gestalt of this invention is explained at a detail. As shown in <u>drawing 3</u> , the data area 14 where information is recorded is established in the periphery by the side of nothing and its magnetic-recording front face in the discoid to which the substrate 11 which constitutes the substrate 10 for magnetic-recording media has a circular hole 12 at the core.

[0013] The ingredient which forms a substrate 11 is an inorganic material, for example, it is desirable to use the ingredient which begins glass and has a nonmagnetic ingredient called metals, such as glass ceramics other than glass, ceramics, and aluminum, etc. or ferrimagnetism, and ferromagnetism. In addition, in addition to said inorganic material, the substrate ingredient which has ferrimagnetism and ferromagnetism uses organic materials, such as synthetic resin, as a base material, and is obtained by distributing the magnetic substance, such as the ferrimagnetic substance, such as ferromagnetics, such as metals of simple substances, such as iron, cobalt, and nickel, and those alloys, and a ferrite, in the base material.
[0014] In the data area 14 of a substrate 11, by immersion-processing or scrub processing under different processing conditions using an acid processing agent, continuation formation of the detailed irregularity is carried out isotropic, and the irregularity does not contain asperity. Immersion processing is an approach immersed into an acid processing agent under predetermined conditions in a substrate 11. Scrub processing (or scrub etching processing) is the approach of etching, while carrying out impregnation of the acid processing agent to the pad formed by resin with a degree of hardness smaller than a substrate 11 etc. beforehand and rubbing the front face of a substrate 11 with this pad.
[0015] In addition, when said asperity specifically measures the field of the arbitration of a substrate material-list side with an atomic force microscope (AFM), it means a high projection relatively compared with the projection which exists discretely and selectively in the projection which has the average height which occupies most measuring planes, and has average height.
[0016] As an acid processing agent used for the surface treatment of a substrate 11, water solutions, such as fluoric acid, a sulfuric acid, a nitric acid, a phosphoric acid, and a hydrochloric acid, are mentioned, for example. Moreover, in order to raise the engine performance of scrub etching processing, at least one sort of additives of chelating agents, such as ethylenediaminetetraacetic acid (EDTA) and a nit ROTORI acetic acid (NTA), and a surfactant may be blended with this acid processing agent if needed.
[0017] By the way, generally it is known for the field of surface science in the maximum surface layer and bulk layer on the front face of a solid-state that a presentation differs from structure etc. in a certain form. this invention persons thought that there was a certain difference in the maximum surface layer and a bulk layer also about the glass substrate 11, and conducted various experiments. For example, polish of a substrate 11 and the conditions of storage were changed, etching processing was performed, and the condition of the front face of the substrate 11 after the processing was observed. It found out that the conditions on the front face of a substrate differed for every conditions through these experiments. And the result of an experiment to this invention persons came to presume that the chemical deterioration layer by the cleaning agent before the mechanical deterioration layer by the mechanical distortion at the time of polish etc. and etching processing, the ion exchange with the storage ambient atmosphere of a substrate, etc. exists in an ununiformity in dozens thru/or a depth of about 1000nm from the maximum front face of a substrate 11.
[0018] Therefore, it is thought that the uneven existence of the deterioration layer which exists in a substrate material-list side which was mentioned above became a local difference in the substrate material-list side in etching processing, and generating of the asperity at the time of carrying out etching processing appeared.
[0019] In addition, the insoluble or poorly soluble foreign matter produced as a cause of generating of asperity when an acid processing agent reacts with glass is mentioned. In this case, it is also considered that the insoluble or poorly soluble foreign matter itself becomes asperity, or the difference of the height by etching arises between the part to which the foreign matter has adhered, and the part which is not so, and asperity occurs according to the masking effect of a foreign matter in etching.
[0020] As a desirable approach for controlling generating of asperity and forming minute irregularity, the approach of carrying out scrub etching for example, of the substrate material-list side is mentioned. When an acid processing agent is fluoric acid, as for the conditions of scrub etching, it is desirable that 0.01 - 1 % of the weight and temperature are [5-60 degrees C and the processing time] 1 - 300 seconds for the concentration. If a reaction rate becomes late practical less when the concentration becomes lower than 0.01 % of the weight, and it becomes high from 1 % of the weight by one side, it will become easy to generate a foreign matter on the front face of a substrate 11, and the corrosion of a scrub etching system will become remarkable. Furthermore, when the temperature is lower than 5 degrees C, a large-sized cooling system is needed separately, on the other hand, it becomes remarkable, when higher than 60 degrees C difficultly fluoric acid's volatilizing concentration management, and an exhaust air facility is needed.
[0021] After scrub etching under existence of an acid processing agent, immersion processing by the alkaline processing agent is performed. By performing this processing, it can prevent that the foreign matter which becomes the front face of a substrate 11 from an alkali-metal salt deposits. That is, the endurance of a substrate 11 can be made to improve. As this alkaline processing agent, at least one sort, such as alkali-metal salts, such as a potassium hydroxide, phosphate, silicate, and aqueous ammonia, is used. Moreover, the additive mentioned above can also be blended with this alkaline processing agent. Furthermore, as for the class, concentration, and temperature of the alkaline above-mentioned processing agent, it is desirable to perform conditioning so that pH to which the dissolution of the silicon dioxide (SiO_2) which is the principal component which constitutes glass becomes remarkable may become 11 or more desirably nine or more.
[0022] Here, asperity in case the projection X which has the larger height h2 than h1 exists in the projection group which has the average height h1 is examined. As an approach of specifying asperity concretely, the approach of determining with the absolute value of height is mentioned. That is, the degree of the relative height of the projection X to the projection group which has the average height h1 is determined by taking the ratio of the height h2 of a certain projection X, and the height h1 of an average projection. Therefore, the degree (it is henceforth called an asperity ratio and AR for short) of height is expressed with the following formula (1) about Projection X.
[0023] $AR=h2/h1$ ... (1)
However, AR of a formula (1) receives each asperity. Generally it is difficult for one or more asperity to exist in the substrate material-list side in many cases, and to, calculate h1 and h2 of each projection on the other hand. Therefore, what is necessary is just to approximate using the known parameter which is having h1 and the h binary standardized, in order to enable it to calculate AR value easily.
[0024] As a parameter representing the above h1, Ra (average side granularity) is considered that Rz (ten-point average side granularity) is the most suitable as a parameter representing h2. AR is expressed with a degree type (2) when these parameters are used.
[0025] $AR=Rz/Ra$ ... (2)
Measurement of the granularity containing the asperity in this invention is performed by measuring a substrate front face with the tapping mode AFM. As for the granularity containing said asperity, a measurement field is defined in length and the 20 micrometers

wide range from length and 5 micrometers wide. Average side granularity Ra and the ten-point average side granularity Rz which are used in case AR value is calculated are JIS. It extends to three dimensions so that arithmetical-mean-deviation-of-profile Ra and the ten-point average of roughness height Rz which are defined by B0601 can be applied to the above-mentioned measuring plane.
[0026] However, when it excels and a high projection does not exist in addition to a crevice being extremely deep as highly as a projection calls it asperity, either, as shown in drawing 1 (a) for example, if concavo-convex granularity estimates AR by Ra and Rz, the definition of Rz to AR becomes large seemingly. In such a case, since the height of a projection group was not equal within the limits of R, this invention persons considered asperity and the height of a projection that an option needs to estimate it concavo-convex granularity.
[0027] As an approach of evaluating the set condition of the height of a projection of minute irregularity, by making the main height of a concavo-convex field into datum level, a projection group is cut in respect of being parallel to the datum level located in the height of arbitration from this datum level, and the approach of measuring the number of projections cut is mentioned. At this time, the main height of a concavo-convex field is height which averaged the depth of all the crevices in the substrate front face from this field, and the height of a projection on the basis of the field of a certain arbitration, and is height when levelling all the concavo-convex fields.
[0028] It is thought that this assessment approach will be the same approach as assessment of AR by Rz/Ra if the height which averaged the depth of all crevices and the height of a projection is considered to be Ra. However, when the granularity of the concavo-convex field in a measuring plane itself is large as mentioned above, the height of datum level may become the height and the equivalent of an average projection, or it may become low, and another parameter which is not related as for the granularity of a concavo-convex field estimates the set condition of the height of a projection. And this invention persons considered using a bearing depth {Z (X %)} as a parameter.
[0029] Here, a bearing depth {Z (X %)} is explained. As shown in drawing 1 (b), when the field of arbitration is measured with an atomic force microscope (AFM) etc., it cuts in respect of extending a projection group in a measuring plane and parallel in the location of the predetermined depth [in this measurement field] from the top-most vertices of highest projection. As shown in drawing 2 , the depth from the top-most vertices of highest projection in case the value which totaled the area of the cutting plane of a projection group in this field becomes X% of the area of a measurement field is a bearing depth {Z (X %)}.
[0030] How to specify AR using this bearing depth {Z (X %)} is examined. When a bearing depth {Z (X %)} cuts a projection group in the field located in the depth of arbitration from the top-most vertices of highest projection paying attention to having specified the depth from the top-most vertices of a projection, this invention persons made the projection group X which has the top-most vertices which do not reach this field the projection group which has average height, and considered the projection Y of the projection group cut to this to be asperity. And I thought that there was so little asperity that the difference of the height of the projection group X and the height of Projection Y is so small that [that is,] the height of Projection Y is low, and the projection group to which height was equal was obtained. The degree of the relative height of the projection Y to the projection group X which has the average height h3 is determined by taking a ratio with the depth h4 from the projection Y to the height h3 of the projection group X to the projection group X. Therefore, AR about Projection Y is expressed with the following type (3).
[0031] AR=h4/h3 ... (3)
Here, when the height of Projection Y is set to h5, the height h3 of the projection group X is expressed by the following formula (4) by the depth h4 and height h5.
[0032] h3=h5-h4 ... (4)
The above-mentioned formula (3) is expressed with the following formula (5) from the relation of the above-mentioned formula (4).
AR=h4/(h5-h4) ... (5)
In case this invention persons specify AR, using a bearing depth {Z (X %)} as a parameter representing the above h4, Z (1%) is considered to be the most suitable from the paper of Ishihara and others considered as reference. That is, when CSS is evaluated using the magnetic-recording medium in which the island-like bump with the flat parietal region was formed according to Ishihara and others, if the surface ratio of the bump parietal region has the best CSS endurance before and behind 0.5 - 1% and separates from said range, CSS endurance shows clearly that it deteriorates remarkably (H Ishihara et al, Wear, 172 (1994) 65-72). In the magnetic-recording medium in which this result had the concavo-convex side where the height of two or more projections differs respectively The more area when the height of the projection in which the area at the time of slicing a concavo-convex field on the basis of the highest projection is contained by 0.5 - 1% slices a concavo-convex field is small as compared with the height of the projection which exists at 0.5 - 1% or more, the more The desirable thing is suggested to improvement in endurance of CSS. For this reason, this invention persons assumed the projection included within the limits of Z (1%) to be asperity, and were taken as the parameter representing h4.
[0033] And as a parameter representing the above h5, said datum level is assumed to be the location where the sum total of the area of the cutting plane of a projection group becomes 50% to the area of a measuring plane, and Z (50%) is considered to be the most suitable. For example, the more X % is smaller than 50% in a bearing depth, it is influenced of an unusually high projection, it becomes easy to change the value of AR and X % is conversely larger than 50%, it is influenced of a deep crevice, is tended to change the value of AR, and, the more becomes. On the other hand, it is because it is thought that the value Z (50%) is a value which is mostly equivalent to the main height of all concavo-convex fields, and is the smallest, so variation by the measurement part can be made small and it becomes an effective index. [of fluctuation of AR value by an unusually high projection or existence of a deep crevice]
[0034] AR is expressed with a degree type (6) when these parameters are used.
AR=Z(1%)/{Z(50%)-Z (1%)} ... (6)
Measurement of the height containing asperity is performed like measurement of granularity. Moreover, a measurement field is also the same range. And a bearing depth {Z (X %)} is specified as follows so that it can apply to the above-mentioned measuring plane.
[0035] When the number of data points in an AFM measurement field is set to n, the data value of i-th AFM is set to Zi and the sequence of numbers which consists of Zi is set to A, a sequence of numbers A is shown like a degree type (7).
[0036]
Sequence of numbers A {Z1, Z2, ..., Zn} ... (7)
When the sequence of numbers which arranged Zi value of this sequence of numbers A in an order from the large thing is set to B, a sequence of numbers B is shown like a degree type (8).
[0037]

Sequence of numbers B {Z'1, Z'2, ..., Z'n} ... (8)
And depth Z [in / in the sum total of the area of the cutting plane of the projection group to the area of a measuring plane / X %] (X %) is defined like a degree type (9).
[0038]
Z(X %) =Z'1-Z' (X/100) xn ...(9)
This expresses that the 5th Z'i value is the depth at this time from the large value from the number of data points being located in a line in an order from what has 10 [large], then the large Z'i value of a sequence of numbers B, when asking for the depth of the location where the sum total of the area of the cutting plane of a projection group becomes 50% from the area of a measuring plane. And since Z (X %) becomes an exact value the more the more there are many data points, the number of data points of a measurement field is carried out to beyond 65536 point (256 per die length of the side of length or width).
[0039] AR which Ra is 0.4-3.0nm, and AR shown by concavo-convex granularity is 14 or less, and shows the glass substrate for magnetic disks of this invention by the bearing depth is three or less. Ra is 0.4-1.0nm more preferably, and AR shown by concavo-convex granularity is 11 or less, and AR shown by the bearing depth is two or less. Not to mention CSS, this substrate fits utilization to the magnetic recording medium of ramped loading or a contact method, and can solve the problem of densification and adhesion simultaneously.
[0040] Next, the presentation at the time of using a substrate ingredient as glass is explained. Although both alumino silicate glass glass ceramics soda lime glass, etc. are used, the alumino silicate glass which expresses with mol % and has the following presentations is suitable for the glass as a substrate ingredient. This alumino silicate glass is because the detailed irregularity which does not have asperity can be formed in a substrate material-list side.
[0041]
Oxidation silicon (SiO_2) 40 - 72% Aluminum oxide (aluminum 2O3) 0.5 - 25% Lithium oxide (Li_2O) 0 - 22% Sodium oxide (Na_2O) 0 - 14% Potassium oxide (K_2O) 0 - 10%, R2O 2 - 30% However, R2 O=Li2 O+Na2 O+K2O Magnesium oxide (MgO) 0 - 25% Calcium oxide (CaO) 0 - 25% Strontium oxide (SrO) 0 - 10% Barium oxide (BaO) 0 - 10%, RO 0 - 40% However, RO=MgO+CaO+SrO+BaO Titanium oxide (TiO_2) 0 - 10% The glass with which the sum total of the component of 0 - 10% or more of zirconium dioxides (ZrO_2) has such [95% or more] a presentation It can manufacture with a float glass process, and melting temperature is low, and the water resisting property and weatherability after chemical-strengthening processing are good, and, moreover, have an usable expansion coefficient combining metal goods. A float glass process is an approach of holding melting tin, flowing melting glass from an end all over the hot bus which made up space the reducing atmosphere, extending glass from the other end, and manufacturing tabular glass. According to this float glass process, the glass obtained has parallel both sides, while there is no distortion and there is surface gloss, high production is possible, modification of the board width is also easy, and it is also easy to attain automation.
[0042] In the above glass presentations, SiO2 is the major component of glass and is an indispensable constituent. When the content is less than 40 % of the weight, the water resisting property after the ion exchange for consolidation processing gets worse, and when exceeding 72 % of the weight, while the viscosity of glass melt becomes high too much and melting and shaping become difficult, an expansion coefficient becomes small too much.
[0043] aluminum 2O3 is a component required in order to make an ion-exchange rate quick and to raise the water resisting property after the ion exchange. When exceeding 25 % of the weight, while such effectiveness is inadequate when the content is less than 0.5 % of the weight, the viscosity of glass melt becomes high too much and melting and shaping become difficult, an expansion coefficient becomes small too much.
[0044] Li2O is a component which raises solubility while being an indispensable constituent for performing the ion exchange. When the content exceeds 22 % of the weight, while the water resisting property after the ion exchange gets worse, liquid phase temperature goes up and shaping becomes difficult.
[0045] Na2O is a component which raises solubility. When the content exceeds 14 % of the weight, the water resisting property after the ion exchange gets worse. Moreover, K2O is a component which raises solubility, and when the content exceeds 10 % of the weight, the surface pressure shrinkage stress after the ion exchange declines.
[0046] furthermore, the total of the above-mentioned Li2O, Na2O, and K2O -- when R2O is less than 2 % of the weight, while the viscosity of glass melt becomes high too much and melting and shaping become difficult, when an expansion coefficient becomes small too much and exceeds 30 % of the weight, the water resisting property after the ion exchange gets worse.
[0047] MgO is a component which raises solubility, when exceeding 25 % of the weight, liquid phase temperature goes up and shaping becomes difficult. CaO is an indispensable component for adjusting an ion-exchange rate while being a component which raises solubility. When the content exceeds 25 % of the weight, liquid phase temperature goes up and shaping becomes difficult. SrO is a component effective in lowering liquid phase temperature while being a component which raises solubility. When the content exceeds 10 % of the weight, while the consistency of glass becomes large, a manufacturing cost rises. BaO is a component effective in lowering liquid phase temperature while being a component which raises solubility. When the content exceeds 10 % of the weight, while the consistency of glass becomes large, a manufacturing cost rises.
[0048] Furthermore, when the sum total RO of Above MgO, CaO, SrO, and BaO exceeds 40 % of the weight, liquid phase temperature goes up and shaping becomes difficult. When TiO2 exceeds 10 % of the weight, while the quality of a glass base deteriorates, a manufacturing cost rises. When ZrO2 exceeds 10 % of the weight, the melting temperature of a glass base or viscosity goes up, and manufacture of a glass substrate ingredient tends to become difficult.
[0049] As for said glass, it is desirable to perform chemical-strengthening processing to the front face in order to maintain the reinforcement demanded as a substrate for magnetic-recording media. It is immersed into the fused salt containing the metal ion of monovalence with a bigger ionic radius than the metal ion of monovalence with which glass is contained during that presentation, and this chemical-strengthening processing is performed by carrying out the ion exchange of the metal ion in glass, and the metal ion in fused salt.
[0050] For example, by being immersed into the potassium-nitrate solution which had the glass substrate heated, the sodium ion near the glass substrate front face is transposed to the potassium ion which has a bigger ionic radius than it, as a result, compressive stress acts, and a glass substrate front face is strengthened. Moreover, a glass substrate may be immersed from 30 minutes for 1 hour into the mixed solution of a silver nitrate (0.5 - 3%), and a potassium nitrate (97 - 99.5%). Complex ion permeates a glass substrate front face promptly by that cause, and the consolidation on the front face of a glass substrate is promoted. Moreover, it can replace with the mixed solution of a silver nitrate and a potassium nitrate, and the mixed solution of a potassium nitrate and a sodium nitrate can be used.
[0051] New irregularity can be formed by giving processing means, such as an exposure of a laser beam, further to fields other than

data area 14 of the substrate 11 with which the minute irregularity which does not have asperity in a front face as mentioned above was formed. High power is easily obtained for what was obtained as a laser beam by being wavelength as it is or carrying out wavelength conversion of the YAG laser at the wavelength of 1/2 and a quadrant, and it is desirable from equipment being comparatively cheap.

[0052] Moreover, as glass which constitutes a substrate 11, the absorption-of-light multiplier of the glass in the wavelength of 266nm of a laser beam is desirable from the ability of the thing of the range of 20-2000mm-1 to form new irregularity with a sufficient precision. The projection formed of the exposure of a laser beam is the thing of a flat-surface circle configuration, and is arranged almost regularly. This projection is range 1-20 micrometers and whose spacing 5-100nm and a diameter are 1-100 micrometers for height.

[0053] Next, a substrate layer, a magnetic layer, a protective layer, etc. are formed in order of sputtering, and a magnetic-recording medium is produced by the front face of the substrates 11, such as a glass substrate obtained as mentioned above, by it. Specifically as a substrate layer, a carbonaceous (C) layer etc. is mentioned as the layer of chromium (Cr)-molybdenum (Mo), and a magnetic layer as the layer of a cobalt (Co)-platinum (Pt)-chromium (Cr)-tantalum (Ta), and a protective layer. Furthermore, the lubricating layer by the thing of a perfluoro polyether system may be formed as lubricant on it.

[0054] According to the above operation gestalten, the following effectiveness is demonstrated.

- Average side granularity Ra on the front face of a substrate is 0.4-3.0nm, and the ratio of the ten-point average side granularity (Rz) on the front face of a substrate to the average side granularity on the front face of a substrate (Ra) is 14 or less. And since the ratio of Z (1%) to the reference value {Z(50%)-Z (1%)} by the bearing depth formed the minute irregularity which is three or less, while being stabilized and being able to form minute irregularity without asperity The height of a projection can be arranged so that it may become almost uniform, it is stabilized and the recorded information can be read.

[0055] - By having formed the substrate 11 by the non-magnetic material, it is magnetized in the direction of a field parallel to a substrate 11, and when it is the magnetic-recording medium of the longitudinal direction recording method by which information is recorded, the magnetic layer prepared on the substrate 11 can cancel the nonconformity of the self-demagnetization produced by being influenced of the MAG from a substrate 11.

[0056] - By having formed the substrate 11 with the magnetic material, it is magnetized for example, in the thickness direction, and when it is the magnetic-recording medium of vertical magnetic recording by which information is recorded, the substrate film etc. can be omitted and constituted, the film configuration prepared on a substrate 11 can be simplified, and thickness can be made thin.

[0057] - When reading the information on which the magnetic head etc. was recorded by having prepared minute irregularity in the data area 14, it can prevent that a head head sticks to the front face of a data area 14, and it is stabilized and read-out of information can be performed.

[0058] - By forming new irregularity in fields other than data area 14 by giving processing means, such as an exposure of a laser beam, in the magnetic-recording medium of CSS, a field for a slider to stabilize and make take-off and landing can be formed, and the field for cleaning foreign matters, such as detailed dust (contamination) to which it adhered in the slider side, can be prepared in the magnetic-recording medium of ramped loading.

[0059]

[Example] Hereafter, an example and the example of a comparison are given and said operation gestalt is explained still more concretely. In addition, this invention is not limited to those examples.

(Example 1) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches by which the chemical strengthening was carried out, scrub washing was carried out using pure water. Subsequently, it pulled up, after being immersed for 1.5 minutes, carrying out scrub etching in a 35-degree C fluoric acid water solution by concentration 0.1% of the weight, and after being further immersed in the pottasium hydroxide solution of pH12 for 2.5 minutes, it pulled up. Then, scrub washing was again carried out using pure water. This was made into the sample of an example 1.

(Example 2) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches and setting Ra of the front face to 0.3-0.6nm, scrub washing was carried out using pure water. Next, after being immersed rocking a glass substrate for 2.5 minutes in a 50-degree C fluoric acid (HF) water solution at 0.1 % of the weight, the rinse was carried out by hot pure water, and the drug solution was removed. Then, soak cleaning was carried out rocking for 2.5 minutes in the potassium-hydroxide water solution adjusted to pH12, the rinse was carried out with hot pure water and pure water after that, and the drug solution was removed. Next, irradiating a supersonic wave at the bath of isopropyl alcohol, soak cleaning of the glass substrate was carried out, and, finally it was dried for 1 minute in the isopropyl alcohol steam.

[0060] Next, in the solution containing a potassium, the ion exchange was performed and chemical-strengthening processing was performed. Then, after fully washing the salt adhering to a glass substrate front face by rinsing, irradiating a supersonic wave for 30 seconds in the potassium-hydroxide water solution adjusted to pH11, soak cleaning was carried out, and scrub washing was performed continuously. Next, soak cleaning was carried out, irradiating a supersonic wave for 160 seconds in the potassium-hydroxide water solution again adjusted to pH11. Subsequently, repeating the actuation which immerses and carries out a rinse to a pure-water bath several times, and irradiating a supersonic wave then at the bath of isopropyl alcohol, soak cleaning of the glass substrate was carried out, and, finally it was dried for 1 minute in the isopropyl alcohol steam. This was made into the sample of an example 2.

(Example 3) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches by which the chemical strengthening was carried out, scrub washing was carried out using pure water. Next, it pulled up, after being immersed rocking a glass substrate for 30 minutes in a 40-degree C fluoric acid (HF) water solution at 0.03 % of the weight, and after being immersed for 2.5 minutes in the potassium-hydroxide water solution further adjusted to pH12, it pulled up. Then, scrub washing was again carried out using pure water. This was made into the sample of an example 3.

(Example 4) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches by which the chemical strengthening was carried out, scrub washing was carried out using pure water. Subsequently, raising and after being immersed carrying out a rinse with pure water and rocking for 30 minutes in a 27-degree C fluoric acid water solution by concentration further 0.01% of the weight, after being immersed rocking for 2.5 minutes in a 50-degree C fluoric acid water solution by concentration 0.1% of the weight, and being further immersed in the pottasium hydroxide solution of pH12 for 2.5 minutes, it pulled up. Then, scrub washing was again carried out using pure water. This was made into the sample of an example 4.

(Example 1 of a comparison) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches by which the chemical strengthening was carried out, scrub washing was carried out using pure water.

Next, it pulled up, after being immersed rocking a glass substrate for 10 minutes in 0.01% of the weight of a fluoric acid (HF) water solution, and after being immersed for 2.5 minutes in the potassium-hydroxide water solution further adjusted to pH12, it pulled up. Then, scrub washing was again carried out using pure water. This was made into the sample of the example 1 of a comparison.
(Example 2 of a comparison) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches, scrub washing was carried out using pure water. Next, it pulled up, after being immersed rocking a glass substrate for 30 minutes in a 40-degree-C fluoric acid (HF) water solution at 0.005 % of the weight, and after being immersed for 2.5 minutes in the potassium-hydroxide water solution further adjusted to pH13, it pulled up. Then, scrub washing was again carried out using pure water. This was made into the sample of the example 2 of a comparison.
(Assessment of a minute irregularity configuration) the above-mentioned examples 1-4 and the examples 1-2 of a comparison -- a scanning probe mold microscope (digital instrument company make --) It observes with a 10micrometerx10micrometer visual field by the nano scope III. Average side granularity Ra, It asked for the asperity ratio (Z(1%)/{Z(50%)-Z (1%)}) which defined ten-point average side granularity by the ratio of the asperity ratio (Rz/Ra) which is the value broken by average side granularity, and a bearing depth, and collected into a table 1. In addition, it had the continuous concavo-convex configuration which does not have a flat part substantially [between a crevice or a projection] isotropic [the minute irregularity of all the measured samples].
[0061]
[A table 1]

	平均面粗さ Ra(nm)	アスペリティレシオ Rz／Ra	アスペリティレシオ Z(1%)／{Z(50%)－Z(1%)}
実施例1	1.0	10.0	1.1
実施例2	1.1	12.0	1.4
実施例3	1.0	13.8	2.4
実施例4	0.9	12.3	2.8
比較例1	1.0	32.0	9.5
比較例2	1.0	17.7	1.9

As shown in a table 1, in the examples 1 and 2, each was able to produce the glass substrate with small asperity ratio (Rz/Ra) and asperity ratio (Z(1%)/{Z(50%)-Z (1%)}) as small [Ra value] as 1.0 order. Although Ra value was as small as 1.0 in the example 3, Rz/Ra was a little high a little as compared with 13.8 and examples 1 and 2. In addition, Z(1%)/{Z(50%)-Z (1%)} was 2.4, and was a little high a little as compared with examples 1 and 2. In the example 4, Ra value is a value small at 0.9, and Rz/Ra was able to produce 12.3 and a small glass substrate. However, although Rz/Ra was a value smaller than an example 3, Z(1%)/{Z(50%)-Z (1%)} is 2.8, and became a big value as compared with the example 3.
[0062] On the other hand, in the example 1 of a comparison, although Ra value was small, Rz/Ra was 32.0, Z(1%)/{Z(50%)-Z (1%)} is 9.5, and it became quite large as compared with examples 1-4. In the example 2 of a comparison, although Ra value was small like the example 1 of a comparison, Rz/Ra was 17.7, and although it was a value quite smaller than the example 1 of a comparison, the value higher than examples 1-4 was shown. However, Z(1%)/{Z(50%)-Z (1%)} is 1.9, and the value lower than examples 3 and 4 was shown.
[0063] Moreover, in the examples 1 and 2 of a comparison, it was checked that asperity exists discretely clearly also from the bird's-eye view of an atomic force microscope (AFM). It was shown that it is more more desirable than the above result that Ra is the range which is 0.4-1.0nm, and Rz/Ra is 12 or less, and Z(1%)/{Z(50%)-Z (1%)} is two or less.
[0064] And since dispersion in the height of a projection cannot be evaluated when only Rz/Ra estimates asperity, and the asperity which exists discretely cannot be evaluated when Z(1%)/{Z(50%)-Z (1%)} estimates asperity conversely, it is thought effective to evaluate asperity by making these two into an index.
(Assessment of the minute irregularity configuration of a magnetic-recording medium) On the front face of the substrate obtained in the example 1, the example 1 of a comparison, and the example 2 of a comparison By sputtering, one by one A (Titanium Ti)-silicon (Si) seed layer (25nm), The chromium (Cr)-(molybdenum Mo) substrate layer (25nm), the cobalt (Co)-(nickel nickel)-chromium (Cr)-tantalum (Ta) magnetic layer (20nm), and the carbon (C) protective layer (10nm) were formed. Then, the thing of a perfluoro polyether system was applied as lubricant, the lubricating layer (2nm) was formed, and it considered as the magnetic-recording medium.
[0065] The magnetic-recording medium formed from the glass substrate of the above-mentioned example 1, the example 1 of a comparison, and the example 2 of a comparison was observed by the same approach as assessment of the minute irregularity configuration in a glass substrate, and it asked for the asperity ratio (Rz/Ra) which is the value which broke average side granularity Ra and ten-point average side granularity by average side granularity, and collected into a table 2. In addition, it had the continuous concavo-convex configuration which does not have a flat part substantially [between a crevice or a projection] isotropic [the minute irregularity of all the measured samples].
[0066]
[A table 2]

	ガラス基板		磁気記録媒体	
	平均面粗さ Ra(nm)	アスペリティレシオRz／Ra	平均面粗さ Ra(nm)	アスペリティレシオRz／Ra
実施例1	1.0	10.0	1.0	10.0
比較例1	1.0	32.0	1.0	30.0
比較例2	1.0	17.7	1.0	17.7

As shown in a table 2, in the example 1, the example 1 of a comparison, and the example 2 of a comparison, it was checked that the minute irregularity containing the asperity formed in the substrate front face remains to a lubricating layer front face almost as it is.

(Assessment of a magnetic-recording medium) Seek operation was performed equipping the spindle of the hard disk drive unit of ramped loading with the magnetic-recording medium obtained as mentioned above, and making it rotate by 3600rpm, and surfacing the magnetic head with an acoustic emission sensor, and it acted as the monitor of the output of an acoustic emission sensor.
[0067] In the magnetic-recording medium of an example 1, even if it performed seek operation, the output of the acoustic emission sensor which shows that the magnetic head and a magnetic disk collided was not accepted, and did not have the glide error of the magnetic head. Moreover, the glide hit was not produced, when premature start height was set as 15nm and the glide test was performed. Furthermore, the head crash was not produced although 100,000 times of seek operation was repeated.
[0068] In the magnetic-recording medium of the example 1 of a comparison, when seek operation was performed, the output of an acoustic emission sensor was accepted. Moreover, when 100,000 times of seek operation was repeated, the head crash arose on the way. Also in the magnetic-recording medium of the example 2 of a comparison, the head crash arose on the way as a result of the seek operation whose outputs of an acoustic emission sensor are private seals and 100,000 times like the example 1 of a comparison.
[0069] In addition, it changes as follows and this operation gestalt can also take shape.
- All over the front face of the substrate 11 including a data area 14, the minute irregularity whose Ra is the range which is 0.4-3.0nm, whose Rz/Ra is 14 or less and whose Z(1%)/{Z(50%)-Z (1%)} is three or less may be formed.
[0070] Thus, when constituted, the minute irregularity which controlled generating of asperity can be formed also in fields other than data area 14.
- Minute irregularity is not limited to what is formed of scrub etching processing, but may be formed by immersion processing.
[0071] Thus, minute irregularity can be formed also by immersion processing under predetermined conditions. Furthermore, the technical thought grasped from said operation gestalt is indicated below.
[0072] - It is the range whose average side granularity on the front face of a substrate (Ra) is 0.4-1.0nm. The ratio of the ten-point average side granularity (Rz) on the front face of a substrate to the average side granularity on the front face of a substrate (Ra) is 12 or less. The substrate for magnetic-recording media given in either of claim 1 to claims 4 in which the minute irregularity whose ratio of Z (1%) to a reference value {Z(50%)-Z (1%)} is two or less was formed on the surface of the substrate.
[0073] Thus, when constituted, the configuration and granularity of minute irregularity which are formed in a substrate front face can be made still more suitable. - Said substrate is a substrate for magnetic-recording media according to claim 2 or 4 which is a glass substrate and is characterized by forming detailed irregularity by scrub etching.
[0074] Thus, when constituted, the configuration and granularity of minute irregularity which are formed in a substrate front face can be controlled suitably.
[0075]
[Effect of the Invention] According to this invention, the following effectiveness is done so as explained in full detail above. While according to the substrate for magnetic-recording media of invention according to claim 1 being stabilized and being able to form minute irregularity without asperity, the height of a projection can be arranged so that it may become almost uniform, it is stabilized and the recorded information can be read.
[0076] According to the substrate for magnetic-recording media of invention according to claim 2, in addition to an effect of the invention according to claim 1, it is stabilized and the magnetic layer prepared on a substrate can be formed. If it is the magnetic-recording medium of vertical magnetic recording, since the substrate film etc. is [according to the substrate for magnetic-recording media of invention according to claim 3] omissible in addition to an effect of the invention according to claim 1, the film configuration prepared on a substrate can be simplified and thickness can be made thin.
[0077] According to the substrate for magnetic-recording media of invention according to claim 4, it is stabilized more and the information which is recorded on either of claims 3 in addition to the effect of the invention of a publication can be read from claim 1.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] It is related with the substrate for magnetic-recording media used for magnetic-recording media, such as an information recording apparatus, especially a hard disk drive unit. It is related with the substrate for magnetic-recording media used for the hard disk drive unit which has various heads, such as the so-called CSS, ramped loading, and a contact method, a disk, and an interface in more detail.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In order to raise the consistency of magnetic recording, preventing generating of adhesion of the magnetic head and a magnetic disk in the hard disk drive unit of the type with which the magnetic head surfaces at the time of actuation like CSS or ramped loading, and the hard disk drive unit with which the magnetic head is called the contact method which always touches the front face of a magnetic disk at the time of actuation and a halt, it has been necessary to form irregularity (for it to be about 0.4 to 3nm at surface roughness Ra) still minuter than before in a magnetic-disk front face.
[0003] The technique which forms such minuter irregularity in the substrate front face which consists of inorganic materials, such as glass, by etching processing is examined partly in the past. For example, in JP,5-314456,A, the technique which forms irregularity is indicated by etching a glass substrate with the mixed solution of fluoric acid and a potassium fluoride.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, the following effectiveness is done so as explained in full detail above. While according to the substrate for magnetic-recording media of invention according to claim 1 being stabilized and being able to form minute irregularity without asperity, the height of a projection can be arranged so that it may become almost uniform, it is stabilized and the recorded information can be read.
[0076] According to the substrate for magnetic-recording media of invention according to claim 2, in addition to an effect of the invention according to claim 1, it is stabilized and the magnetic layer prepared on a substrate can be formed. If it is the magnetic-recording medium of vertical magnetic recording, since the substrate film etc. is [according to the substrate for magnetic-recording media of invention according to claim 3] omissible in addition to an effect of the invention according to claim 1, the film configuration prepared on a substrate can be simplified and thickness can be made thin.
[0077] According to the substrate for magnetic-recording media of invention according to claim 4, it is stabilized more and the information which is recorded on either of claims 3 in addition to the effect of the invention of a publication can be read from claim 1.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, according to these conventional techniques, the average irregularity formed has this invention persons quite larger than average target minute irregularity. Then, although this invention persons examined target minute irregularity according to etching conditions other than said conventional technique by re-evaluating etching conditions, there was a case where excelled rather than the height of the average projection called asperity, and it generated discretely [a high projection] or selectively. Moreover, even if it was the case where a projection high like it calls it asperity did not exist, there was a case where the height of each projection became an ununiformity.
[0005] And when the projection with uneven minute irregularity which has asperity or its height produced a magnetic disk using the glass substrate formed in the front face, there was a problem of causing a head crash, or generating a noise when reading the information recorded on the magnetic disk.
[0006] Furthermore, the configuration of INTAFEISU between heads, such as a head which has the head at the time of the storing approach of a head like ramped loading and a contact method and the head at the time of a hard disk drive unit halt between disks or hard disk drive unit actuation, the existence of contact of a disk and various slider configurations, and floatation and a transit property in recent years in addition to CSS, a disk, and a head and a disk is being diversified.
[0007] Since the design of each head, a disk, and an interface changes with manufacturers who assemble a hard disk drive unit, this is considered to have suggested that the granularity on the front face of a magnetic disk needed and the height of a projection change delicately with each assembly manufacturers. So, as for the granularity of the minute irregularity formed in a substrate front face, and the height of a projection, it is desirable that it is controllable to delicacy and accuracy.
[0008] This invention is made paying attention to the trouble which exists in the above conventional techniques. The place made into the object can arrange the height of a projection so that it may become almost uniform, and is to offer the substrate for magnetic-recording media which is stabilized and can read the recorded information while being stabilized and being able to form minute irregularity without asperity.

[Translation done.]

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned object, invention of the substrate for magnetic-recording media according to claim 1 The minute irregularity which has a projection group is formed in a substrate front face, and it is the range whose average side granularity on the front face of a substrate (Ra) is 0.4-3.0nm. The ratio of the ten-point average side granularity (Rz) on the front face of a substrate to the average side granularity on the front face of a substrate (Ra) is 14 or less. And when a projection group is cut from the top-most vertices of the highest projection in a predetermined field in respect of being parallel to the substrate front face in the location of the predetermined depth, When the depth in case the value which totaled the area of the cutting plane of each projection within the field becomes X% of the area of the predetermined field on the front face of a substrate is set to Z (X %), the ratio of Z (1%) to a reference value {Z(50%)-Z (1%)} forms the minute irregularity which is three or less on the surface of a substrate.
[0010] Invention of the substrate for magnetic-recording media according to claim 2 is characterized by said substrate consisting of non-magnetic materials, such as glass, glass ceramics, ceramics, and aluminum, in invention according to claim 1.
[0011] As for said substrate, invention of the substrate for magnetic-recording media according to claim 3 is characterized by having ferrimagnetism or ferromagnetism in invention according to claim 1. Said substrate has the data area where, as for invention of the substrate for magnetic-recording media according to claim 4, information is recorded on the front face in invention given in either of claim 1 to claims 3, and forms said minute irregularity in a data area at least.
[0012]
[Embodiment of the Invention] Below, the operation gestalt of this invention is explained at a detail. As shown in drawing 3 , the data area 14 where information is recorded is established in the periphery by the side of nothing and its magnetic-recording front face in the discoid to which the substrate 11 which constitutes the substrate 10 for magnetic-recording media has a circular hole 12 at the core.
[0013] The ingredient which forms a substrate 11 is an inorganic material, for example, it is desirable to use the ingredient which begins glass and has a nonmagnetic ingredient called metals, such as glass ceramics other than glass, ceramics, and aluminum, etc. or ferrimagnetism, and ferromagnetism. In addition, in addition to said inorganic material, the substrate ingredient which has ferrimagnetism and ferromagnetism uses organic materials, such as synthetic resin, as a base material, and is obtained by distributing the magnetic substance, such as the ferrimagnetic substance, such as ferromagnetics, such as metals of simple substances, such as iron, cobalt, and nickel, and those alloys, and a ferrite, in the base material.
[0014] In the data area 14 of a substrate 11, by immersion-processing or scrub processing under different processing conditions using an acid processing agent, continuation formation of the detailed irregularity is carried out isotropic, and the irregularity does not contain asperity. Immersion processing is an approach immersed into an acid processing agent under predetermined conditions in a substrate 11. Scrub processing (or scrub etching processing) is the approach of etching, while carrying out impregnation of the acid processing agent to the pad formed by resin with a degree of hardness smaller than a substrate 11 etc. beforehand and rubbing the front face of a substrate 11 with this pad.
[0015] In addition, when said asperity specifically measures the field of the arbitration of a substrate material-list side with an atomic force microscope (AFM), it means a high projection relatively compared with the projection which exists discretely and selectively in the projection which has the average height which occupies most measuring planes, and has average height.
[0016] As an acid processing agent used for the surface treatment of a substrate 11, water solutions, such as fluoric acid, a sulfuric acid, a nitric acid, a phosphoric acid, and a hydrochloric acid, are mentioned, for example. Moreover, in order to raise the engine performance of scrub etching processing, at least one sort of additives of chelating agents, such as ethylenediaminetetraacetic acid (EDTA) and a nit ROTORI acetic acid (NTA), and a surfactant may be blended with this acid processing agent if needed.
[0017] By the way, generally it is known for the field of surface science in the maximum surface layer and bulk layer on the front face of a solid-state that a presentation differs from structure etc. in a certain form. this invention persons thought that there was a certain difference in the maximum surface layer and a bulk layer also about the glass substrate 11, and conducted various experiments. For example, polish of a substrate 11 and the conditions of storage were changed, etching processing was performed, and the condition of the front face of the substrate 11 after the processing was observed. It found out that the conditions on the front face of a substrate differed for every conditions through these experiments. And the result of an experiment to this invention persons came to presume that the chemical deterioration layer by the cleaning agent before the mechanical deterioration layer by the mechanical distortion at the time of polish etc. and etching processing, the ion exchange with the storage ambient atmosphere of a substrate, etc. exists in an ununiformity in dozens thru/or a depth of about 1000nm from the maximum front face of a substrate 11.
[0018] Therefore, it is thought that the uneven existence of the deterioration layer which exists in a substrate material-list side which was mentioned above became a local difference in the substrate material-list side in etching processing, and generating of the asperity at the time of carrying out etching processing appeared.
[0019] In addition, the insoluble or poorly soluble foreign matter produced as a cause of generating of asperity when an acid processing agent reacts with glass is mentioned. In this case, it is also considered that the insoluble or poorly soluble foreign matter itself becomes asperity, or the difference of the height by etching arises between the part to which the foreign matter has adhered, and the part which is not so, and asperity occurs according to the masking effect of a foreign matter in etching.
[0020] As a desirable approach for controlling generating of asperity and forming minute irregularity, the approach of carrying out

scrub etching for example, of the substrate material-list side is mentioned. When an acid processing agent is fluoric acid, as for the conditions of scrub etching, it is desirable that 0.01 - 1 % of the weight and temperature are [5-60 degrees C and the processing time] 1 - 300 seconds for the concentration. If a reaction rate becomes late practical less when the concentration becomes lower than 0.01 % of the weight, and it becomes high from 1 % of the weight by one side, it will become easy to generate a foreign matter on the front face of a substrate 11, and the corrosion of a scrub etching system will become remarkable. Furthermore, when the temperature is lower than 5 degrees C, a large-sized cooling system is needed separately, on the other hand, it becomes remarkable, when higher than 60 degrees C difficultly fluoric acid's volatilizing concentration management, and an exhaust air facility is needed.

[0021] After scrub etching under existence of an acid processing agent, immersion processing by the alkaline processing agent is performed. By performing this processing, it can prevent that the foreign matter which becomes the front face of a substrate 11 from an alkali-metal salt deposits. That is, the endurance of a substrate 11 can be made to improve. As this alkaline processing agent, at least one sort, such as alkali-metal salts, such as a potassium hydroxide, phosphate, silicate, and aqueous ammonia, is used. Moreover, the additive mentioned above can also be blended with this alkaline processing agent. Furthermore, as for the class, concentration, and temperature of the alkaline above-mentioned processing agent, it is desirable to perform conditioning so that pH to which the dissolution of the silicon dioxide (SiO_2) which is the principal component which constitutes glass becomes remarkable may become 11 or more desirably nine or more.

[0022] Here, asperity in case the projection X which has the larger height h2 than h1 exists in the projection group which has the average height h1 is examined. As an approach of specifying asperity concretely, the approach of determining with the absolute value of height is mentioned. That is, the degree of the relative height of the projection X to the projection group which has the average height h1 is determined by taking the ratio of the height h2 of a certain projection X, and the height h1 of an average projection. Therefore, the degree (it is henceforth called an asperity ratio and AR for short) of height is expressed with the following formula (1) about Projection X.

[0023] AR=h2/h1 ... (1)

However, AR of a formula (1) receives each asperity. Generally it is difficult for one or more asperity to exist in the substrate material-list side in many cases, and to, calculate h1 and h2 of each projection on the other hand. Therefore, what is necessary is just to approximate using the known parameter which is having h1 and the h binary standardized, in order to enable it to calculate AR value easily.

[0024] As a parameter representing the above h1, Ra (average side granularity) is considered that Rz (ten-point average side granularity) is the most suitable as a parameter representing h2. AR is expressed with a degree type (2) when these parameters are used.

[0025] AR=Rz/Ra ... (2)

Measurement of the granularity containing the asperity in this invention is performed by measuring a substrate front face with the tapping mode AFM. As for the granularity containing said asperity, a measurement field is defined in length and the 20 micrometers wide range from length and 5 micrometers wide. Average side granularity Ra and the ten-point average side granularity Rz which are used in case AR value is calculated are JIS. It extends to three dimensions so that arithmetical-mean-deviation-of-profile Ra and the ten-point average of roughness height Rz which are defined by B0601 can be applied to the above-mentioned measuring plane.

[0026] However, when it excels and a high projection does not exist in addition to a crevice being extremely deep as highly as a projection calls it asperity, either, as shown in drawing 1 (a) for example, if concavo-convex granularity estimates AR by Ra and Rz, the definition of Rz to AR becomes large seemingly. In such a case, since the height of a projection group was not equal within the limits of R, this invention persons considered asperity and the height of a projection that an option needs to estimate it concavo-convex granularity.

[0027] As an approach of evaluating the set condition of the height of a projection of minute irregularity, by making the main height of a concavo-convex field into datum level, a projection group is cut in respect of being parallel to the datum level located in the height of arbitration from this datum level, and the approach of measuring the number of projections cut is mentioned. At this time, the main height of a concavo-convex field is height which averaged the depth of all the crevices in the substrate front face from this field, and the height of a projection on the basis of the field of a certain arbitration, and is height when levelling all the concavo-convex fields.

[0028] It is thought that this assessment approach will be the same approach as assessment of AR by Rz/Ra if the height which averaged the depth of all crevices and the height of a projection is considered to be Ra. However, when the granularity of the concavo-convex field in a measuring plane itself is large as mentioned above, the height of datum level may become the height and the equivalent of an average projection, or it may become low, and another parameter which is not related as for the granularity of a concavo-convex field estimates the set condition of the height of a projection. And this invention persons considered using a bearing depth {Z (X %)} as a parameter.

[0029] Here, a bearing depth {Z (X %)} is explained. As shown in drawing 1 (b), when the field of arbitration is measured with an atomic force microscope (AFM) etc., it cuts in respect of extending a projection group in a measuring plane and parallel in the location of the predetermined depth [in this measurement field] from the top-most vertices of highest projection. As shown in drawing 2 , the depth from the top-most vertices of highest projection in case the value which totaled the area of the cutting plane of a projection group in this field becomes X% of the area of a measurement field is a bearing depth {Z (X %)}.

[0030] How to specify AR using this bearing depth {Z (X %)} is examined. When a bearing depth {Z (X %)} cuts a projection group in the field located in the depth of arbitration from the top-most vertices of highest projection paying attention to having specified the depth from the top-most vertices of a projection, this invention persons made the projection group X which has the top-most vertices which do not reach this field the projection group which has average height, and considered the projection Y of the projection group cut to this to be asperity. And I thought that there was so little asperity that the difference of the height of the projection group X and the height of Projection Y is so small that [that is,] the height of Projection Y is low, and the projection group to which height was equal was obtained. The degree of the relative height of the projection Y to the projection group X which has the average height h3 is determined by taking a ratio with the depth h4 from the projection Y to the height h3 of the projection group X to the projection group X. Therefore, AR about Projection Y is expressed with the following type (3).

[0031] AR=h4/h3 ... (3)

Here, when the height of Projection Y is set to h5, the height h3 of the projection group X is expressed by the following formula (4) by the depth h4 and height h5.

[0032] h3=h5-h4 ... (4)
The above-mentioned formula (3) is expressed with the following formula (5) from the relation of the above-mentioned formula (4).
AR=h4/(h5-h4) ... (5)
In case this invention persons specify AR, using a bearing depth {Z (X %)} as a parameter representing the above h4, Z (1%) is considered to be the most suitable from the paper of Ishihara and others considered as reference. That is, when CSS is evaluated using the magnetic-recording medium in which the island-like bump with the flat parietal region was formed according to Ishihara and others, if the surface ratio of the bump parietal region has the best CSS endurance before and behind 0.5 - 1% and separates from said range, CSS endurance shows clearly that it deteriorates remarkably (H Ishihara et al, Wear, 172 (1994) 65-72). In the magnetic-recording medium in which this result had the concavo-convex side where the height of two or more projections differs respectively The more area when the height of the projection in which the area at the time of slicing a concavo-convex field on the basis of the highest projection is contained by 0.5 - 1% slices a concavo-convex field is small as compared with the height of the projection which exists at 0.5 - 1% or more, the more The desirable thing is suggested to improvement in endurance of CSS. For this reason, this invention persons assumed the projection included within the limits of Z (1%) to be asperity, and were taken as the parameter representing h4.
[0033] And as a parameter representing the above h5, said datum level is assumed to be the location where the sum total of the area of the cutting plane of a projection group becomes 50% to the area of a measuring plane, and Z (50%) is considered to be the most suitable. For example, the more X % is smaller than 50% in a bearing depth, it is influenced of an unusually high projection, it becomes easy to change the value of AR and X % is conversely larger than 50%, it is influenced of a deep crevice, is tended to change the value of AR, and, the more becomes. On the other hand, it is because it is thought that the value Z (50%) is a value which is mostly equivalent to the main height of all concavo-convex fields, and is the smallest, so variation by the measurement part can be made small and it becomes an effective index. [of fluctuation of AR value by an unusually high projection or existence of a deep crevice]
[0034] AR is expressed with a degree type (6) when these parameters are used.
AR=Z(1%)/{Z(50%)-Z (1%)} ... (6)
Measurement of the height containing asperity is performed like measurement of granularity. Moreover, a measurement field is also the same range. And a bearing depth {Z (X %)} is specified as follows so that it can apply to the above-mentioned measuring plane.
[0035] When the number of data points in an AFM measurement field is set to n, the data value of i-th AFM is set to Zi and the sequence of numbers which consists of Zi is set to A, a sequence of numbers A is shown like a degree type (7).
[0036]
Sequence of numbers A {Z1, Z2, ..., Zn} ... (7)
When the sequence of numbers which arranged Zi value of this sequence of numbers A in an order from the large thing is set to B, a sequence of numbers B is shown like a degree type (8).
[0037]
Sequence of numbers B {Z'1, Z'2, ..., Z'n} ... (8)
And depth Z [in / in the sum total of the area of the cutting plane of the projection group to the area of a measuring plane / X %] (X %) is defined like a degree type (9).
[0038]
Z(X %) =Z'1-Z' (X/100) xn ... (9)
This expresses that the 5th Z'i value is the depth at this time from the large value from the number of data points being located in a line in an order from what has 10 [large], then the large Z'i value of a sequence of numbers B, when asking for the depth of the location where the sum total of the area of the cutting plane of a projection group becomes 50% from the area of a measuring plane. And since Z (X %) becomes an exact value the more the more there are many data points, the number of data points of a measurement field is carried out to beyond 65536 point (256 per die length of the side of length or width).
[0039] AR which Ra is 0.4-3.0nm, and AR shown by concavo-convex granularity is 14 or less, and shows the glass substrate for magnetic disks of this invention by the bearing depth is three or less. Ra is 0.4-1.0nm more preferably, and AR shown by concavo-convex granularity is 11 or less, and AR shown by the bearing depth is two or less. Not to mention CSS, this substrate fits utilization to the magnetic recording medium of ramped loading or a contact method, and can solve the problem of densification and adhesion simultaneously.
[0040] Next, the presentation at the time of using a substrate ingredient as glass is explained. Although both alumino silicate glass glass ceramics soda lime glass, etc. are used, the alumino silicate glass which expresses with mol % and has the following presentations is suitable for the glass as a substrate ingredient. This alumino silicate glass is because the detailed irregularity which does not have asperity can be formed in a substrate material-list side.
[0041]
Oxidation silicon (SiO2) 40 - 72% Aluminum oxide (aluminum 2O3) 0.5 - 25% Lithium oxide (Li2O) 0 - 22% Sodium oxide (Na2O) 0 - 14% Potassium oxide (K2O) 0 - 10%, R2O 2 - 30% However, R2 O=Li2 O+Na2 O+K2O Magnesium oxide (MgO) 0 - 25% Calcium oxide (CaO) 0 - 25% Strontium oxide (SrO) 0 - 10% Barium oxide (BaO) 0 - 10%, RO 0 - 40% However, RO=MgO+CaO+SrO+BaO Titanium oxide (TiO2) 0 - 10% The glass with which the sum total of the component of 0 - 10% or more of zirconium dioxides (ZrO2) has such [95% or more] a presentation It can manufacture with a float glass process, and melting temperature is low, and the water resisting property and weatherability after chemical-strengthening processing are good, and, moreover, have an usable expansion coefficient combining metal goods. A float glass process is an approach of holding melting tin, flowing melting glass from an end all over the hot bus which made up space the reducing atmosphere, extending glass from the other end, and manufacturing tabular glass. According to this float glass process, the glass obtained has parallel both sides, while there is no distortion and there is surface gloss, high production is possible, modification of the board width is also easy, and it is also easy to attain automation.
[0042] In the above glass presentations, SiO2 is the major component of glass and is an indispensable constituent. When the content is less than 40 % of the weight, the water resisting property of ion-exchange Ushiro for consolidation processing gets worse, and when exceeding 72 % of the weight, while the viscosity of glass melt becomes high too much and melting and shaping become difficult, an expansion coefficient becomes small too much.
[0043] aluminum 2O3 is a component required in order to make an ion-exchange rate quick and to raise ion-exchange Ushiro's water resisting property. When exceeding 25 % of the weight, while such effectiveness is inadequate when the content is less than 0.5 % of the weight, the viscosity of glass melt becomes high too much and melting and shaping become difficult, an expansion coefficient becomes small too much.

[0044] Li2O is a component which raises solubility while being an indispensable constituent for performing the ion exchange. When the content exceeds 22 % of the weight, while ion-exchange Ushiro's water resisting property gets worse, liquid phase temperature goes up and shaping becomes difficult.
[0045] Na2O is a component which raises solubility. When the content exceeds 14 % of the weight, ion-exchange Ushiro's water resisting property gets worse. Moreover, K2O is a component which raises solubility, and when the content exceeds 10 % of the weight, ion-exchange Ushiro's surface pressure shrinkage stress declines.
[0046] furthermore, the total of the above-mentioned Li2O, Na2O, and K2O — when R2O is less than 2 % of the weight, while the viscosity of glass melt becomes high too much and melting and shaping become difficult, when an expansion coefficient becomes small too much and exceeds 30 % of the weight, ion-exchange Ushiro's water resisting property gets worse.
[0047] MgO is a component which raises solubility, when exceeding 25 % of the weight, liquid phase temperature goes up and shaping becomes difficult. CaO is an indispensable component for adjusting an ion-exchange rate while being a component which raises solubility. When the content exceeds 25 % of the weight, liquid phase temperature goes up and shaping becomes difficult. SrO is a component effective in lowering liquid phase temperature while being a component which raises solubility. When the content exceeds 10 % of the weight, while the consistency of glass becomes large, a manufacturing cost rises. BaO is a component effective in lowering liquid phase temperature while being a component which raises solubility. When the content exceeds 10 % of the weight, while the consistency of glass becomes large, a manufacturing cost rises.
[0048] Furthermore, when the sum total RO of Above MgO, CaO, SrO, and BaO exceeds 40 % of the weight, liquid phase temperature goes up and shaping becomes difficult. When TiO2 exceeds 10 % of the weight, while the quality of a glass base deteriorates, a manufacturing cost rises. When ZrO2 exceeds 10 % of the weight, the melting temperature of a glass base or viscosity goes up, and manufacture of a glass substrate ingredient tends to become difficult.
[0049] As for said glass, it is desirable to perform chemical-strengthening processing to the front face in order to maintain the reinforcement demanded as a substrate for magnetic-recording media. It is immersed into the fused salt containing the metal ion of monovalence with a bigger ionic radius than the metal ion of monovalence with which glass is contained during that presentation, and this chemical-strengthening processing is performed by carrying out the ion exchange of the metal ion in glass, and the metal ion in fused salt.
[0050] For example, by being immersed into the potassium-nitrate solution which had the glass substrate heated, the sodium ion near the glass substrate front face is transposed to the potassium ion which has a bigger ionic radius than it, as a result, compressive stress acts, and a glass substrate front face is strengthened. Moreover, a glass substrate may be immersed from 30 minutes for 1 hour into the mixed solution of a silver nitrate (0.5 - 3%), and a potassium nitrate (97 - 99.5%). Complex ion permeates a glass substrate front face promptly by that cause, and the consolidation on the front face of a glass substrate is promoted. Moreover, it can replace with the mixed solution of a silver nitrate and a potassium nitrate, and the mixed solution of a potassium nitrate and a sodium nitrate can be used.
[0051] New irregularity can be formed by giving processing means, such as an exposure of a laser beam, further to fields other than data area 14 of the substrate 11 with which the minute irregularity which does not have asperity in a front face as mentioned above was formed. High power is easily obtained for what was obtained as a laser beam by being wavelength as it is or carrying out wavelength conversion of the YAG laser at the wavelength of 1/2 and a quadrant, and it is desirable from equipment being comparatively cheap.
[0052] Moreover, as glass which constitutes a substrate 11, the absorption-of-light multiplier of the glass in the wavelength of 266nm of a laser beam is desirable from the ability of the thing of the range of 20-2000mm-1 to form new irregularity with a sufficient precision. The projection formed of the exposure of a laser beam is the thing of a flat-surface circle configuration, and is arranged almost regularly. This projection is range 1-20 micrometers and whose spacing 5-100nm and a diameter are 1-100 micrometers for height.
[0053] Next, a substrate layer, a magnetic layer, a protective layer, etc. are formed in order of sputtering, and a magnetic-recording medium is produced by the front face of the substrates 11, such as a glass substrate obtained as mentioned above, by it. Specifically as a substrate layer, a carbonaceous (C) layer etc. is mentioned as the layer of chromium (Cr)-molybdenum (Mo), and a magnetic layer as the layer of a cobalt (Co)-platinum (Pt)-chromium (Cr)-tantalum (Ta), and a protective layer. Furthermore, the lubricating layer by the thing of a perfluoro polyether system may be formed as lubricant on it.
[0054] According to the above operation gestalten, the following effectiveness is demonstrated.
- Average side granularity Ra on the front face of a substrate is 0.4-3.0nm, and the ratio of the ten-point average side granularity (Rz) on the front face of a substrate to the average side granularity on the front face of a substrate (Ra) is 14 or less. And since the ratio of Z (1%) to the reference value {Z(50%)-Z (1%)} by the bearing depth formed the minute irregularity which is three or less, while being stabilized and being able to form minute irregularity without asperity The height of a projection can be arranged so that it may become almost uniform, it is stabilized and the recorded information can be read.
[0055] - By having formed the substrate 11 by the non-magnetic material, it is magnetized in the direction of a field parallel to a substrate 11, and when it is the magnetic-recording medium of the longitudinal direction recording method by which information is recorded, the magnetic layer prepared on the substrate 11 can cancel the nonconformity of the self-demagnetization produced by being influenced of the MAG from a substrate 11.
[0056] - By having formed the substrate 11 with the magnetic material, it is magnetized for example, in the thickness direction, and when it is the magnetic-recording medium of vertical magnetic recording by which information is recorded, the substrate film etc. can be omitted and constituted, the film configuration prepared on a substrate 11 can be simplified, and thickness can be made thin.

[0057] - When reading the information on which the magnetic head etc. was recorded by having prepared minute irregularity in the data area 14, it can prevent that a head head sticks to the front face of a data area 14, and it is stabilized and read-out of information can be performed.
[0058] - By forming new irregularity in fields other than data area 14 by giving processing means, such as an exposure of a laser beam, in the magnetic-recording medium of CSS, a field for a slider to stabilize and make take-off and landing can be formed, and the field for cleaning foreign matters, such as detailed dust (contamination) to which it adhered in the slider side, can be prepared in the magnetic-recording medium of ramped loading.

[Translation done.]

EXAMPLE

[Example] Hereafter, an example and the example of a comparison are given and said operation gestalt is explained still more concretely. In addition, this invention is not limited to those examples.
(Example 1) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches by which the chemical strengthening was carried out, scrub washing was carried out using pure water. Subsequently, it pulled up, after being immersed for 1.5 minutes, carrying out scrub etching in a 35-degree C fluoric acid water solution by concentration 0.1% of the weight, and after being further immersed in the pottasium hydroxide solution of pH12 for 2.5 minutes, it pulled up. Then, scrub washing was again carried out using pure water. This was made into the sample of an example 1.
(Example 2) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches and setting Ra of the front face to 0.3-0.6nm, scrub washing was carried out using pure water. Next, after being immersed rocking a glass substrate for 2.5 minutes in a 50-degree C fluoric acid (HF) water solution at 0.1 % of the weight, the rinse was carried out by hot pure water, and the drug solution was removed. Then, soak cleaning was carried out rocking for 2.5 minutes in the potassium-hydroxide water solution adjusted to pH12, the rinse was carried out with hot pure water and pure water after that, and the drug solution was removed. Next, irradiating a supersonic wave at the bath of isopropyl alcohol, soak cleaning of the glass substrate was carried out, and, finally it was dried for 1 minute in the isopropyl alcohol steam.
[0060] Next, in the solution containing a potassium, the ion exchange was performed and chemical-strengthening processing was performed. Then, after fully washing the salt adhering to a glass substrate front face by rinsing, irradiating a supersonic wave for 30 seconds in the potassium-hydroxide water solution adjusted to pH11, soak cleaning was carried out, and scrub washing was performed continuously. Next, soak cleaning was carried out, irradiating a supersonic wave for 160 seconds in the potassium-hydroxide water solution again adjusted to pH11. Subsequently, repeating the actuation which immerses and carries out a rinse to a pure-water bath several times, and irradiating a supersonic wave then at the bath of isopropyl alcohol, soak cleaning of the glass substrate was carried out, and, finally it was dried for 1 minute in the isopropyl alcohol steam. This was made into the sample of an example 2.
(Example 3) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches by which the chemical strengthening was carried out, scrub washing was carried out using pure water. Next, it pulled up, after being immersed rocking a glass substrate for 30 minutes in a 40-degree C fluoric acid (HF) water solution at 0.03 % of the weight, and after being immersed for 2.5 minutes in the potassium-hydroxide water solution further adjusted to pH12, it pulled up. Then, scrub washing was again carried out using pure water. This was made into the sample of an example 3.
(Example 4) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches by which the chemical strengthening was carried out, scrub washing was carried out using pure water. Subsequently, raising and after being immersed carrying out a rinse with pure water and rocking for 30 minutes in a 27-degree C fluoric acid water solution by concentration further 0.01% of the weight, after being immersed rocking for 2.5 minutes in a 50-degree C fluoric acid water solution by concentration 0.1% of the weight, and being further immersed in the pottasium hydroxide solution of pH12 for 2.5 minutes, it pulled up. Then, scrub washing was again carried out using pure water. This was made into the sample of an example 4.
(Example 1 of a comparison) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches by which the chemical strengthening was carried out, scrub washing was carried out using pure water. Next, it pulled up, after being immersed rocking a glass substrate for 10 minutes in 0.01% of the weight of a fluoric acid (HF) water solution, and after being immersed for 2.5 minutes in the potassium-hydroxide water solution further adjusted to pH12, it pulled up. Then, scrub washing was again carried out using pure water. This was made into the sample of the example 1 of a comparison.
(Example 2 of a comparison) After carrying out precision polish of the front face of an alumino silicate glass substrate ingredient with a diameter of 2.5 inches, scrub washing was carried out using pure water. Next, it pulled up, after being immersed rocking a glass substrate for 30 minutes in a 40-degree C fluoric acid (HF) water solution at 0.005 % of the weight, and after being immersed for 2.5 minutes in the potassium-hydroxide water solution further adjusted to pH13, it pulled up. Then, scrub washing was again carried out using pure water. This was made into the sample of the example 2 of a comparison.
(Assessment of a minute irregularity configuration) The above-mentioned examples 1-4 and the examples 1-2 of a comparison It observes with a 10micrometerx10micrometer visual field under a scanning probe mold microscope (digital instrument company make and nano scope III). It asked for the asperity ratio (Z(1%)/[Z(50%)-Z (1%)]) which defined average side granularity Ra and ten-point average side granularity by the ratio of the asperity ratio (Rz/Ra) which is the value broken by average side granularity, and a bearing depth, and collected into a table 1. In addition, it had the continuous concavo-convex configuration which does not have a flat part substantially [between a crevice or a projection] isotropic [the minute irregularity of all the measured samples].
[0061]
[A table 1]

	平均面粗さ Ra(nm)	アスペリティレシオ Rz／Ra	アスペリティレシオ Z(1%)／{Z(50%)－Z(1%)}
実施例1	1.0	10.0	[illegible]
実施例2	1.1	12.0	1.4
実施例3	1.0	13.8	2.4
実施例4	0.9	12.3	2.8
比較例1	1.0	32.0	9.5
比較例2	1.0	17.7	1.9

As shown in a table 1, in the examples 1 and 2, each was able to produce the glass substrate with small asperity ratio (Rz/Ra) and asperity ratio (Z(1%)/{Z(50%)-Z (1%)}) as small [Ra value] as 1.0 order. Although Ra value was as small as 1.0 in the example 3, Rz/Ra was a little high a little as compared with 13.8 and examples 1 and 2. In addition, Z(1%)/{Z(50%)-Z (1%)} was 2.4, and was a little high a little as compared with examples 1 and 2. In the example 4, Ra value is a value small at 0.9, and Rz/Ra was able to produce 12.3 and a small glass substrate. However, although Rz/Ra was a value smaller than an example 3, Z(1%)/{Z(50%)-Z (1%)} is 2.8, and became a big value as compared with the example 3.

[0062] On the other hand, in the example 1 of a comparison, although Ra value was small, Rz/Ra was 32.0, Z(1%)/{Z(50%)-Z (1%)} is 9.5, and it became quite large as compared with examples 1-4. In the example 2 of a comparison, although Ra value was small like the example 1 of a comparison, Rz/Ra was 17.7, and although it was a value quite smaller than the example 1 of a comparison, the value higher than examples 1-4 was shown. However, Z(1%)/{Z(50%)-Z (1%)} is 1.9, and the value lower than examples 3 and 4 was shown.

[0063] Moreover, in the examples 1 and 2 of a comparison, it was checked that asperity exists discretely clearly also from the bird's-eye view of an atomic force microscope (AFM). It was shown that it is more more desirable than the above result that Ra is the range which is 0.4-1.0nm, and Rz/Ra is 12 or less, and Z(1%)/{Z(50%)-Z (1%)} is two or less.

[0064] And since dispersion in the height of a projection cannot be evaluated when only Rz/Ra estimates asperity, and the asperity which exists discretely cannot be evaluated when Z(1%)/{Z(50%)-Z (1%)} estimates asperity conversely, it is thought effective to evaluate asperity by making these two into an index.

(Assessment of the minute irregularity configuration of a magnetic-recording medium) It is sputtering to the front face of the substrate obtained in the example 1, the example 1 of a comparison, and the example 2 of a comparison. The (Titanium Ti)-silicon (Si) seed layer (25nm), the chromium (Cr)-(molybdenum Mo) substrate layer (25nm), the cobalt (Co)-(nickel nickel)-chromium (Cr)-tantalum (Ta) magnetic layer (20nm), and the carbon (C) protective layer (10nm) were formed one by one. Then, the thing of a perfluoro polyether system was applied as lubricant, the lubricating layer (2nm) was formed, and it considered as the magnetic-recording medium.

[0065] The magnetic-recording medium formed from the glass substrate of the above-mentioned example 1, the example 1 of a comparison, and the example 2 of a comparison was observed by the same approach as assessment of the minute irregularity configuration in a glass substrate, and it asked for the asperity ratio (Rz/Ra) which is the value which broke average side granularity Ra and ten-point average side granularity by average side granularity, and collected into a table 2. In addition, it had the continuous concavo-convex configuration which does not have a flat part substantially [between a crevice or a projection] isotropic [the minute irregularity of all the measured samples].

[0066]

[A table 2]

	ガラス基板		磁気記録媒体	
	平均面粗さ Ra(nm)	アスペリティレシオRz／Ra	平均面粗さ Ra(nm)	アスペリティレシオRz／Ra
実施例1	1.0	10.0	1.0	10.0
比較例1	1.0	32.0	1.0	30.0
比較例2	1.0	17.7	1.0	17.7

As shown in a table 2, in the example 1, the example 1 of a comparison, and the example 2 of a comparison, it was checked that the minute irregularity containing the asperity formed in the substrate front face remains to a lubricating layer front face almost as it is.

(Assessment of a magnetic-recording medium) Seek operation was performed equipping the spindle of the hard disk drive unit of ramped loading with the magnetic-recording medium obtained as mentioned above, and making it rotate by 3600rpm, and surfacing the magnetic head with an acoustic emission sensor, and it acted as the monitor of the output of an acoustic emission sensor.

[0067] In the magnetic-recording medium of an example 1, even if it performed seek operation, the output of the acoustic emission sensor which shows that the magnetic head and a magnetic disk collided was not accepted, and did not have the glide error of the magnetic head. Moreover, the glide hit was not produced, when premature start height was set as 15nm and the glide test was performed. Furthermore, the head crash was not produced although 100,000 times of seek operation was repeated.

[0068] In the magnetic-recording medium of the example 1 of a comparison, when seek operation was performed, the output of an acoustic emission sensor was accepted. Moreover, when 100,000 times of seek operation was repeated, the head crash arose on the way. Also in the magnetic-recording medium of the example 2 of a comparison, the head crash arose on the way as a result of the seek operation whose outputs of an acoustic emission sensor are private seals and 100,000 times like the example 1 of a comparison.

[0069] In addition, it changes as follows and this operation gestalt can also take shape.

- All over the front face of the substrate 11 including a data area 14, the minute irregularity whose Ra is the range which is 0.4-3.0nm, whose Rz/Ra is 14 or less and whose Z(1%)/[Z(50%)-Z (1%)] is three or less may be formed.

[0070] Thus, when constituted, the minute irregularity which controlled generating of asperity can be formed also in fields other than data area 14.

- Minute irregularity is not limited to what is formed of scrub etching processing, but may be formed by immersion processing.

[0071] Thus, minute irregularity can be formed also by immersion processing under predetermined conditions. Furthermore, the technical thought grasped from said operation gestalt is indicated below.

[0072] - Minute irregularity whose ratio of Z (1%) to a reference value {Z(50%)-Z (1%)} the average side granularity on the front face of a substrate (Ra) is the range which is 0.4-1.0nm, the ratio of the ten-point average side granularity (Rz) on the front face of a substrate to the average side granularity on the front face of a substrate (Ra) is 12 or less, and is two or less The substrate for magnetic-recording media given in either of claim 1 to claims 4 formed on the surface of the substrate.

[0073] Thus, when constituted, the configuration and granularity of minute irregularity which are formed in a substrate front face can be made still more suitable. - Said substrate is a substrate for magnetic-recording media according to claim 2 or 4 which is a glass substrate and is characterized by forming detailed irregularity by scrub etching.

[0074] Thus, when constituted, the configuration and granularity of minute irregularity which are formed in a substrate front face can be controlled suitably.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] For (a), (b) is the conceptual diagram showing the substrate front face of the condition that the granularity of minute irregularity is coarse, and the conceptual diagram showing the substrate front face in the condition that the height of minute irregularity varied.
[Drawing 2] The sectional view in 2-2 line of drawing 1 (b).
[Drawing 3] The top view showing a magnetic-recording medium.
[Description of Notations]
10 — The substrate for magnetic-recording media, 11 — A substrate, 14 — Data area.

[Translation done.]

* NOTICES *

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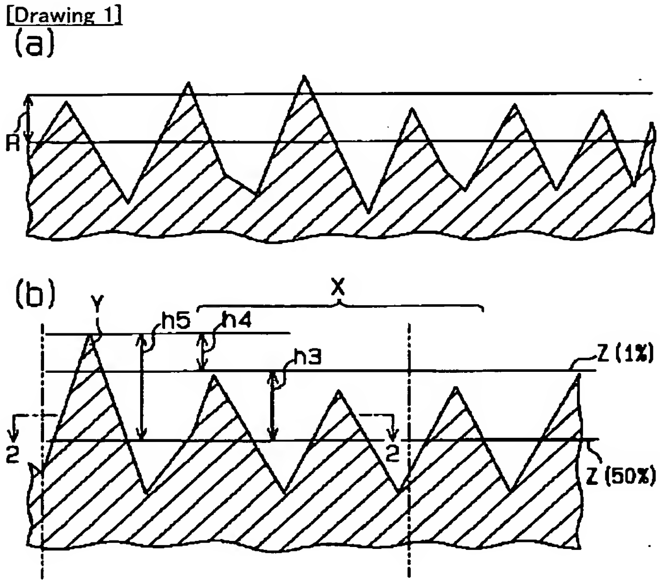
damages caused by the use of this translation.

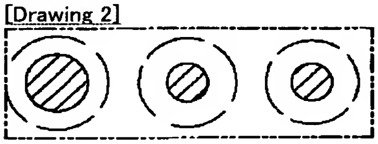
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

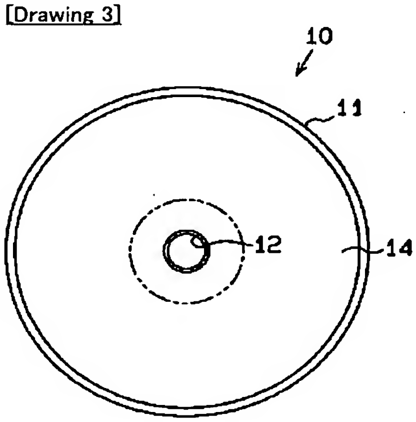
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]

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(54)【発明の名称】　磁気記録媒体用基板

(57)【要約】
【課題】　アスペリティのない微小凹凸を安定して形成することができるとともに、突起の高さをほぼ均一となるように揃えることができ、記録された情報を安定して読み取ることができる磁気記録媒体用基板を提供する。
【解決手段】　磁気記録媒体用基板１０の基板１１は、その表面の平均面粗さＲａが０．４～３．０ｎｍの範囲であり、平均面粗さ（Ｒａ）に対する１０点平均面粗さ（Ｒｚ）の比が１４以下である微小凹凸を有している。加えて、微小凹凸は、所定領域内で最も高い突起の頂点から所定深さの位置にある基板表面と平行な面で突起群を切断した場合、その面内における各突起の切断面の面積を合計した値が基板表面の所定領域の面積のＸ％となるときの深さをＺ（Ｘ％）としたとき、基準値｛Ｚ（５０％）－Ｚ（１％）｝に対するＺ（１％）の比が３以下に設定されている。

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【特許請求の範囲】

【請求項１】　基板表面に突起群を有する微小な凹凸を形成し、基板表面の平均面粗さ（Ｒａ）が０．４～３．０ｎｍの範囲であり、基板表面の平均面粗さ（Ｒａ）に対する基板表面の１０点平均面粗さ（Ｒｚ）の比が１４以下であり、かつ、所定領域内で最も高い突起の頂点から所定深さの位置における基板表面と平行な面で突起群を切断した場合、その面内における各突起の切断面の面積を合計した値が基板表面の所定領域の面積のＸ％となるときの深さをＺ（Ｘ％）としたとき、基準値｛Ｚ（５０％）－Ｚ（１％）｝に対するＺ（１％）の比が３以下である微小凹凸を基板の表面に形成した磁気記録媒体用基板。

【請求項２】　前記基板がガラス、結晶化ガラス、セラミックス、アルミニウム等の非磁性材料からなることを特徴とする請求項１に記載の磁気記録媒体用基板。

【請求項３】　前記基板はフェリ磁性又は強磁性を有することを特徴とする請求項１に記載の磁気記録媒体用基板。

【請求項４】　前記基板はその表面に情報が記録されるデータ領域を有し、少なくともデータ領域に前記微小凹凸を形成した請求項１から請求項３のいずれかに記載の磁気記録媒体用基板。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】情報記録装置、特にハードディスク装置等のような磁気記録媒体に用いられる磁気記録媒体用基板に関するものである。さらに詳しくは、いわゆるＣＳＳ方式、ランプロード方式及びコンタクト方式等の種々のヘッド、ディスク、インターフェイスを有するハードディスク装置に使用される磁気記録媒体用基板に関するものである。

【０００２】

【従来の技術】ＣＳＳ方式やランプロード方式のような駆動時に磁気ヘッドが浮上するタイプのハードディスク装置や、駆動時及び停止時に磁気ヘッドが磁気ディスクの表面と常に接触しているコンタクト方式と呼ばれるハードディスク装置においては、磁気ヘッドと磁気ディスクの粘着の発生を防ぎつつ磁気記録の密度を上げるために、従来よりもさらに微小な凹凸（表面粗さＲａで０．４から３ｎｍ程度）を磁気ディスク表面に形成することが必要となってきた。

【０００３】このような、より微小な凹凸をエッチング処理によりガラス等の無機材料からなる基板表面に形成する技術は過去に幾つか検討されている。例えば、特開平５－３１４４５６号公報では、ガラス基板をフッ酸とフッ化カリウムの混合溶液にてエッチングすることにより凹凸を形成する技術が開示されている。

【０００４】

【発明が解決しようとする課題】ところが、これらの従

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来技術によれば、形成される平均的な凹凸は本発明者らが目標とする平均的な微小凹凸よりもかなり大きい。そこで、本発明者らはエッチング条件を再検討することにより、前記従来技術以外のエッチング条件によって目標とする微小凹凸の検討を行ったが、アスペリティと呼ばれる平均的な突起の高さよりも飛び抜けて高い突起が離散的又は部分的に発生する場合があった。また、アスペリティと呼ぶ程の高い突起が存在しない場合であっても、各突起の高さが不均一になる場合があった。

【０００５】そして、アスペリティを有する微小凹凸、あるいはその高さが不均一な突起が表面に形成されたガラス基板を用いて磁気ディスクを作製した場合、ヘッドクラッシュを引き起こしたり、磁気ディスクに記録された情報を読みとるときノイズを発生したりするという問題があった。

【０００６】さらに、近年に於いてはＣＳＳ方式以外にランプロード方式や、コンタクト方式のようなヘッドとディスク間のハードディスク装置停止時のヘッドの格納方法やハードディスク装置駆動時のヘッドとディスクの接触の有無、また種々のスライダ形状、浮上と走行特性を有するヘッド等、ヘッド、ディスク及びヘッドとディスク間のインタフェーイスの構成が多様化してきている。

【０００７】このことは、ハードディスク装置を組み立てるメーカーにより各々のヘッド、ディスク及びインターフェイスの設計が異なるため、必要とされる磁気ディスク表面の粗さ及び突起の高さが各々の組立メーカーによって微妙に異なってくることを示唆しているものと考えられる。それ故、基板表面に形成される微小凹凸の粗さ及び突起の高さは微妙、かつ正確に制御できることが望ましい。

【０００８】この発明は、上記のような従来技術に存在する問題点に着目してなされたものである。その目的とするところは、アスペリティのない微小凹凸を安定して形成することができるとともに、突起の高さをほぼ均一となるように揃えることができ、記録された情報を安定して読み取ることができる磁気記録媒体用基板を提供することにある。

【０００９】

【課題を解決するための手段】上記の目的を達成するために、請求項１に記載の磁気記録媒体用基板の発明は、基板表面に突起群を有する微小な凹凸を形成し、基板表面の平均面粗さ（Ｒａ）が０．４～３．０ｎｍの範囲であり、基板表面の平均面粗さ（Ｒａ）に対する基板表面の１０点平均面粗さ（Ｒｚ）の比が１４以下であり、かつ、所定領域内で最も高い突起の頂点から所定深さの位置における基板表面と平行な面で突起群を切断した場合、その面内における各突起の切断面の面積を合計した値が基板表面の所定領域の面積のＸ％となるときの深さをＺ（Ｘ％）としたとき、基準値｛Ｚ（５０％）－Ｚ

（１％））に対するＺ（１％）の比が３以下である微小凹凸を基板の表面に形成したものである。

【００１０】請求項２に記載の磁気記録媒体用基板の発明は、請求項１に記載の発明において、前記基板がガラス、結晶化ガラス、セラミックス、アルミニウム等の非磁性材料からなることを特徴とするものである。

【００１１】請求項３に記載の磁気記録媒体用基板の発明は、請求項１に記載の発明において、前記基板はフェリ磁性又は強磁性を有することを特徴とするものである。請求項４に記載の磁気記録媒体用基板の発明は、請求項１から請求項３のいずれかに記載の発明において、前記基板はその表面に情報が記録されるデータ領域を有し、少なくともデータ領域に前記微小凹凸を形成したものである。

【００１２】

【発明の実施の形態】以下に、この発明の実施形態について詳細に説明する。図３に示すように、磁気記録媒体用基板１０を構成する基板１１は中心に円孔１２を有する円盤状をなし、その磁気記録表面側の外周には情報が記録されるデータ領域１４が設けられている。

【００１３】基板１１を形成する材料は無機材料であって、例えばガラスをはじめガラス以外の結晶化ガラス、セラミックス、アルミニウム等の金属等といった非磁性の材料、あるいはフェリ磁性、強磁性を有する材料を使用することが好ましい。なお、フェリ磁性、強磁性を有する基板材料は前記無機材料に加え、合成樹脂等の有機材料を母材とし、その母材中に例えば鉄、コバルト、ニッケル等の単体の金属及びそれらの合金等の強磁性体、フェライト等のフェリ磁性体等の磁性体を分散させることにより得られる。

【００１４】基板１１のデータ領域１４には、酸性処理剤を用いて異なる処理条件下で浸漬処理又はスクラブ処理することにより、微細な凹凸が等方的に連続形成され、かつその凹凸はアスペリティを含まないものとなっている。浸漬処理は基板１１を所定の条件下で酸性処理剤中に浸漬する方法である。スクラブ処理（又はスクラブエッチング処理）は基板１１よりも硬度の小さい樹脂等で形成されたパッドに予め酸性処理剤を含浸させ、このパッドで基板１１の表面を摩擦しながらエッチングする方法である。

【００１５】なお、前記アスペリティとは、具体的には基板材料表面の任意の領域を原子間力顕微鏡（ＡＦＭ）で測定した際に、測定面の大部分を占める平均的な高さを有する突起の中に、離散的、部分的に存在し平均的な高さを有する突起と比べて相対的に高い突起のことをいう。

【００１６】基板１１の表面処理に用いられる酸性処理剤としては、例えばフッ酸、硫酸、硝酸、リン酸、塩酸等の水溶液が挙げられる。また、この酸性処理剤には、スクラブエッチング処理の性能を向上させるために必要に応じてエチレンジアミン四酢酸（ＥＤＴＡ）、ニトロトリ酢酸（ＮＴＡ）等のキレート剤及び界面活性剤の少なくとも１種の添加剤が配合されてもよい。

【００１７】ところで、表面科学の分野では、固体表面の最表面層とバルク層とで、組成や構造等が何らかの形で異なることが一般的に知られている。本発明者らは、ガラス製の基板１１に関しても最表面層とバルク層とで何らかの違いがあるものと考え、種々の実験を行った。例えば、基板１１の研磨や保管の条件を変えてエッチング処理を施し、その処理後の基板１１の表面の状態を観察した。これらの実験を通して、基板表面の状態が条件毎に異なることを見いだした。そして実験の結果から、本発明者らは、基板１１の最表面から数十ないし１０００ｎｍ位の深さでは、研磨時の機械的歪み等による機械的な変質層、エッチング処理前の洗浄剤や基板の保管雰囲気とのイオン交換等による化学的な変質層が不均一に存在すると推定するに至った。

【００１８】従って、エッチング処理した場合のアスペリティの発生は、上述したような基板材料表面に存在する変質層の不均一な存在が、エッチング処理における基板材料表面での局所的な差となって現れたものと考えられる。

【００１９】その他アスペリティの発生原因としては、酸性処理剤がガラスと反応した際に生じる不溶性又は難溶性の異物が挙げられる。この場合、不溶性又は難溶性の異物そのものがアスペリティになったり、エッチングにおいて異物のマスキング効果により、異物が付着している部分とそうでない部分との間でエッチングによる高さの差が生じてアスペリティが発生したりすることも考えられる。

【００２０】アスペリティの発生を抑制して微小凹凸を形成するための好ましい方法として、例えば基板材料表面をスクラブエッチングする方法が挙げられる。スクラブエッチングの条件は、酸性処理剤がフッ酸の場合、その濃度が０．０１～１重量％、温度が５～６０℃及び処理時間が１～３００秒であることが好ましい。その濃度が０．０１重量％より低くなると、反応速度が遅く実用的でなくなり、一方で１重量％より高くなると、基板１１の表面に異物が発生し易くなり、かつスクラブエッチング装置の腐食が著しくなる。さらに、その温度が５℃より低い場合には大型の冷却装置が別途必要となり、一方６０℃より高い場合には、フッ酸の揮発が著しく濃度管理が難しくなり、かつ排気設備が必要となる。

【００２１】酸性処理剤の存在下でのスクラブエッチングの後にはアルカリ性処理剤による浸漬処理が行われる。この処理を施すことにより、基板１１の表面にアルカリ金属塩からなる異物が析出することを防止できる。すなわち、基板１１の耐久性を改善させることができる。このアルカリ性処理剤としては、水酸化カリウム等のアルカリ金属塩類、リン酸塩類、珪酸塩類、アンモニ

ア水等の少なくとも１種が使用される。また、このアルカリ性処理剤には、前述した添加剤を配合することもできる。さらに、上記アルカリ性処理剤の種類、濃度及び温度はガラスを構成する主成分である二酸化ケイ素（SiO_2）の溶解が顕著になるｐＨが９以上、望ましくは１１以上となるように条件設定を行うことが好ましい。

【００２２】ここで、平均的な高さｈ１を有する突起群の中に、ｈ１よりも大きい高さｈ２を有する突起Ｘが存在する場合のアスペリティについて検討する。アスペリティを具体的に規定する方法としては、高さの絶対値によって決定する方法が挙げられる。つまり、平均的な高さｈ１を有する突起群に対する突起Ｘの相対的な高さの度合いは、ある突起Ｘの高さｈ２と平均的な突起の高さｈ１との比をとることにより決定される。従って、突起Ｘについて高さの度合い（以後、アスペリティレシオ、ＡＲと略称する）は、下記式（１）で表される。

【００２３】ＡＲ＝ｈ２／ｈ１　・・・（１）

但し、式（１）のＡＲは各々のアスペリティに対するものである。一方、基板材料表面には１本以上のアスペリティが存在していることが多く、また各々の突起のｈ１，ｈ２を求めることは一般的に難しい。従って、ＡＲ値を容易に求めることができるようにするには、ｈ１，ｈ２値を規格化されている既知のパラメータを用いて近似すればよい。

【００２４】上記ｈ１を代表するパラメータとしてはＲａ（平均面粗さ）が、ｈ２を代表するパラメータとしてはＲｚ（十点平均面粗さ）が最も適当と考えられる。これらのパラメータを用いると、ＡＲは次式（２）で表される。

【００２５】ＡＲ＝Ｒｚ／Ｒａ　・・・（２）

この発明におけるアスペリティを含む粗さの測定は、基板表面をタッピングモードＡＦＭにより測定することによって行われる。前記アスペリティを含む粗さは、測定領域が、縦、横５μｍから縦、横２０μｍの範囲で定義される。ＡＲ値を計算する際に用いる平均面粗さＲａ及び十点平均面粗さＲｚは、ＪＩＳ　Ｂ０６０１で定義されている中心線平均粗さＲａ及び十点平均粗さＲｚを上記測定面に対し適用できるように三次元に拡張したものである。

【００２６】しかし、Ｒａ及びＲｚにより凹凸の粗さでＡＲを評価すると、図１（ａ）に示すように、例えば突起がアスペリティと呼ぶほど高くはなく、凹部が極端に深いことに加え、飛び抜けて高い突起も存在しない場合、Ｒｚの定義からＡＲが見かけ上大きくなる。このような場合、突起群の高さがＲの範囲内に揃わないため、本発明者らはアスペリティ及び突起の高さを凹凸の粗さとは別の方法で評価する必要があると考えた。

【００２７】微小凹凸の突起の高さの揃い具合を評価する方法としては、凹凸面の中心高さを基準面として、この基準面から任意の高さに位置する基準面と平行な面で突起群を切断し、切断される突起数を計測する方法が挙げられる。このとき、凹凸面の中心高さとは、ある任意の面を基準とし、この面からの基板表面における全ての凹部の深さ及び突起の高さを平均した高さであり、全ての凹凸面を地均ししたときの高さである。

【００２８】この評価方法は、全ての凹部の深さ及び突起の高さを平均した高さをＲａと考えれば、Ｒｚ／ＲａによるＡＲの評価と同じ方法であると考えられる。ところが、前記のように測定面における凹凸面の粗さそのものが大きい場合には、基準面の高さが平均的な突起の高さと同値になったり、あるいは低くなったりする場合があり、凹凸面の粗さとは関係ない別のパラメータで突起の高さの揃い具合を評価する。そして、本発明者らはパラメータとして、ベアリング・デプス｛Ｚ（Ｘ％）｝を用いることを考えた。

【００２９】ここで、ベアリング・デプス｛Ｚ（Ｘ％）｝について説明する。図１（ｂ）に示すように、任意の領域を原子間力顕微鏡（ＡＦＭ）等で測定した際、この測定領域内において最も高い突起の頂点から所定深さの位置において、突起群を測定面と平行に延びる面で切断する。図２に示すように、この面内において、突起群の切断面の面積を合計した値が測定領域の面積のＸ％となるときの最も高い突起の頂点からの深さがベアリング・デプス｛Ｚ（Ｘ％）｝である。

【００３０】このベアリング・デプス｛Ｚ（Ｘ％）｝を用いてＡＲを規定する方法について検討する。本発明者らはベアリング・デプス｛Ｚ（Ｘ％）｝が突起の頂点からの深さを規定していることに着目し、最も高い突起の頂点から任意の深さに位置する面で突起群を切断したとき、この面に達しない頂点を有する突起群Ｘを平均的な高さを有する突起群とし、これに対して切断される突起群の突起Ｙをアスペリティと考えた。そして、突起Ｙの高さが低いほど、つまり、突起群Ｘの高さと突起Ｙの高さとの差が小さい程アスペリティが少なく、高さの揃った突起群が得られると考えた。平均的な高さｈ３を有する突起群Ｘに対する突起Ｙの相対的な高さの度合いは、突起群Ｘの高さｈ３に対する突起Ｙから突起群Ｘまでの深さｈ４との比をとることにより決定される。従って、突起ＹについてのＡＲは、下記式（３）で表される。

【００３１】ＡＲ＝ｈ４／ｈ３　・・・（３）

ここで、突起Ｙの高さをｈ５とした場合、突起群Ｘの高さｈ３は深さｈ４及び高さｈ５により、下記式（４）で表される。

【００３２】ｈ３＝ｈ５－ｈ４　・・・（４）

上記式（４）の関係から上記式（３）は下記式（５）で表される。

ＡＲ＝ｈ４／（ｈ５－ｈ４）　・・・（５）

上記ｈ４を代表するパラメータとしては、本発明者らがベアリング・デプス｛Ｚ（Ｘ％）｝を用いてＡＲを規定する際に参考としたＩｓｈｉｈａｒａらの論文から、Ｚ

（１％）が最も適当と考えられる。すなわち、Ｉｓｈｉｈａｒａらによれば、頭頂部が平坦な島状バンプを形成した磁気記録媒体を用いてＣＳＳを評価したとき、バンプ頭頂部の面積比が０．５～１％前後でＣＳＳ耐久性が最も良く、前記範囲を外れるとＣＳＳ耐久性が著しく劣化することを明らかにしている（Ｈ　Ｉｓｈｉｈａｒａ　ｅｔ　ａｌ．Ｗｅａｒ．１７２（１９９４）６５－７２）。この結果は複数個の突起の高さが各々異なる凹凸面を持った磁気記録媒体において、最も高い突起を基点として凹凸面をスライスした場合の面積が０．５～１％までに含まれる突起の高さが凹凸面をスライスした場合の面積が０．５～１％以上で存在する突起の高さと比較して小さければ小さいほど、ＣＳＳの耐久性向上には望ましいことを示唆している。このため、本発明者らはＺ（１％）の範囲内に含まれる突起をアスペリティと仮定し、ｈ４を代表するパラメータとした。＊【００３３】そして、上記ｈ５を代表するパラメータとしては、前記基準面を測定面の面積に対し突起群の切断面の面積の合計が５０％となる位置であると仮定して、Ｚ（５０％）が最も適当と考えられる。例えば、ベアリングデプスにおいて、Ｘ％が５０％よりも小さければ小さいほど、異常に高い突起の影響を受け、ＡＲの値が変動しやすくなり、逆にＸ％が５０％よりも大きければ大きいほど、深い凹部の影響を受け、ＡＲの値が変動しやすくなる。これに対し、Ｚ（５０％）という値は全ての凹凸面の中心高さにほぼ相当する値であり、異常に高い突起や深い凹部の存在によるＡＲ値の変動が最も小さいと考えられるため、測定箇所によるバラツキを小さくでき、有効な指標となるからである。

【００３４】これらのパラメータを用いると、ＡＲは次式（６）で表される。

$$AR = Z(1\%) / \{Z(50\%) - Z(1\%)\} \quad \cdots (6)$$

アスペリティを含む高さの測定は、粗さの測定と同様に行われる。また、測定領域も同一の範囲である。そして、ベアリング・デプス｛Ｚ（Ｘ％）｝は上記測定面に対し適用できるように、以下のように規定される。

【００３５】ＡＦＭ測定領域内のデータポイント数をｎとしたとき、ｉ番目のＡＦＭのデータ値をＺｉとし、Ｚｉからなる数列をＡとすると、数列Ａは次式（７）のように示される。

【００３６】

$$数列A\ \{Z_1, Z_2, \cdots, Z_n\} \quad \cdots (7)$$

この数列ＡのＺｉ値を大きいものから順番に並べた数列をＢとすると数列Ｂは次式（８）のように示される。

【００３７】

$$数列B\ \{Z'_1, Z'_2, \cdots, Z'_n\} \quad \cdots (8)$$

そして、測定面の面積に対する突起群の切断面の面積の合計がＸ％における深さＺ（Ｘ％）は次式（９）のように定義される。

【００３８】

$$Z(X\%) = Z'_1 - Z'_{(X/100)\times n} \quad \cdots (9)$$

これは、例えば測定面の面積に対し、突起群の切断面の面積の合計が５０％となる位置の深さを求める場合、データポイント数が１０とすれば、数列ＢのＺ'ｉ値が大きいものから順番に並んでいることから、大きい値から５番目のＺ'ｉ値がこのときの深さであることを表して※いる。そして、データポイント数が多ければ多いほどＺ（Ｘ％）が正確な値となるため、測定領域のデータポイント数は６５５３６点（縦又は横の辺の長さ当たり２５６点）以上とする。

【００３９】この発明の磁気ディスク用ガラス基板は、Ｒａが０．４～３．０ｎｍであり、凹凸の粗さで示すＡＲが１４以下であり、かつベアリング・デプスで示すＡＲが３以下である。より好ましくはＲａが０．４～１．０ｎｍであり、凹凸の粗さで示すＡＲが１１以下であり、かつベアリング・デプスで示すＡＲが２以下である。この基板は、ＣＳＳ方式はもちろんのこと、ランプロード方式又はコンタクト方式の磁気記録装置への利用に適しており、高密度化と粘着の問題を同時に解決することができる。

【００４０】次に、基板材料をガラスとした場合のその組成について説明する。基板材料としてのガラスは、アルミノシリケートガラス、結晶化ガラス、ソーダライムガラス等のいずれも使用されるが、それらのうちモル％で表して次のような組成を有するアルミノシリケートガラスが好適である。このアルミノシリケートガラスは、基板材料表面にアスペリティを有しない微細な凹凸を形成することができるからである。

【００４１】

酸化珪素（SiO_2）	４０～７２％、
酸化アルミニウム（Al_2O_3）	０．５～２５％、
酸化リチウム（Li_2O）	０～２２％、
酸化ナトリウム（Na_2O）	０～１４％、
酸化カリウム（K_2O）	０～１０％、
R_2O	２～３０％

但し、$R_2O = Li_2O + Na_2O + K_2O$

酸化マグネシウム（MgO）	０～２５％、
酸化カルシウム（CaO）	０～２５％、

酸化ストロンチウム（ＳｒＯ）　０～１０％、
酸化バリウム（ＢａＯ）　０～１０％、
ＲＯ　０～４０％
但し、ＲＯ＝ＭｇＯ＋ＣａＯ＋ＳｒＯ＋ＢａＯ
酸化チタン（TiO_2）　０～１０％
酸化ジルコニウム（ZrO_2）　０～１０％
以上の成分の合計が９５％以上

このような組成を有するガラスは、フロート法により製造可能で、溶融温度が低く、化学強化処理後の耐水性や耐候性が良好で、しかも金属製品と組み合わせて使用可能な膨張係数を有する。フロート法は、溶融スズを収容し、上部空間を還元性雰囲気とした高温のバス中へ、一端から溶融ガラスを流入し、他端からガラスを引き延ばして板状のガラスを製造する方法である。このフロート法によれば、得られるガラスは両面が平行でゆがみがなく、表面光沢があるとともに、多量生産が可能で、板幅の変更も容易であり、自動化を図ることも容易である。

【００４２】前記のようなガラス組成において、SiO_2はガラスの主要成分であり、必須の構成成分である。その含有量が４０重量％未満の場合、強化処理のためのイオン交換後の耐水性が悪化し、７２重量％を越える場合、ガラス融液の粘性が高くなりすぎ、溶融や成形が困難になるとともに、膨張係数が小さくなりすぎる。

【００４３】Al_2O_3はイオン交換速度を速くし、イオン交換後の耐水性を向上させるために必要な成分である。その含有量が０．５重量％未満の場合、そのような効果が不十分であり、２５重量％を越える場合、ガラス融液の粘性が高くなりすぎ、溶融や成形が困難になるとともに、膨張係数が小さくなりすぎる。

【００４４】Li_2Oはイオン交換を行うための必須の構成成分であるとともに、溶解性を高める成分である。その含有量が２２重量％を越える場合、イオン交換後の耐水性が悪化するとともに、液相温度が上がり、成形が困難となる。

【００４５】Na_2Oは溶解性を高める成分である。その含有量が１４重量％を越える場合、イオン交換後の耐水性が悪化する。また、K_2Oは溶解性を高める成分であり、その含有量が１０重量％を越える場合、イオン交換後の表面圧縮応力が低下する。

【００４６】さらに、上記Li_2O、Na_2O及びK_2Oの合計R_2Oが２重量％未満の場合、ガラス融液の粘性が高くなりすぎ、溶融や成形が困難となるとともに、膨張係数が小さくなりすぎ、３０重量％を越える場合、イオン交換後の耐水性が悪化する。

【００４７】ＭｇＯは溶解性を高める成分であり、２５重量％を越える場合、液相温度が上がり、成形が困難になる。ＣａＯは溶解性を高める成分であるとともに、イオン交換速度を調整するための必須成分である。その含有量が２５重量％を越える場合、液相温度が上がり、成形が困難になる。ＳｒＯは溶解性を高める成分であるとともに、液相温度を下げるのに有効な成分である。その含有量が１０重量％を越える場合、ガラスの密度が大きくなるとともに、製造コストが上昇する。ＢａＯは溶解性を高める成分であるとともに、液相温度を下げるのに有効な成分である。その含有量が１０重量％を越える場合、ガラスの密度が大きくなるとともに、製造コストが上昇する。

【００４８】さらに、上記ＭｇＯ、ＣａＯ、ＳｒＯ及びＢａＯの合計ＲＯが、４０重量％を越える場合、液相温度が上がり、成形が困難となる。TiO_2が１０重量％を越える場合、ガラス素地の品質が悪化するとともに、製造コストが上昇する。ZrO_2が１０重量％を越える場合、ガラス素地の溶融温度又は粘性が上昇し、ガラス基板材料の製造が困難になりやすい。

【００４９】前記ガラスは、磁気記録媒体用基板として要求される強度を維持するため、その表面に化学強化処理が施されていることが望ましい。この化学強化処理は、ガラスがその組成中に含まれる一価の金属イオンよりイオン半径が大きな一価の金属イオンを含有する溶融塩中に浸漬され、ガラス中の金属イオンと溶融塩中の金属イオンとがイオン交換されることにより行われる。

【００５０】例えば、ガラス基板を加熱された硝酸カリウム溶液中に浸漬することにより、ガラス基板表面近傍のナトリウムイオンがそれより大きなイオン半径を有するカリウムイオンに置き換えられ、その結果圧縮応力が作用してガラス基板表面が強化される。また、ガラス基板を硝酸銀（０.５～３％）と硝酸カリウム（９７～９９.５％）の混合溶液中に、３０分から１時間浸漬してもよい。それにより、銀イオンがガラス基板表面に速やかに浸透され、ガラス基板表面の強化が促進される。また、硝酸銀と硝酸カリウムの混合溶液に代えて、硝酸カリウムと硝酸ナトリウムの混合溶液を使用することができる。

【００５１】上記のようにして表面にアスペリティの無い微小凹凸が形成された基板１１のデータ領域１４以外の領域に対し、さらにレーザ光の照射等の処理手段を施すことによって新たな凹凸を形成することができる。レーザ光としては、ＹＡＧレーザをそのままの波長で、又は2分の1や4分の1の波長に波長変換して得られたものが、容易に大出力が得られ、装置が比較的安価であることから望ましい。

【００５２】また、基板１１を構成するガラスとしては、レーザ光の波長２６６ｎｍにおけるガラスの光の吸収係数が２０～２０００mm^{-1}の範囲のものが新たな凹

凸を精度良く形成することができることから好ましい。レーザ光の照射によって形成される突起は平面円形状のものでほぼ規則的に配置される。この突起は、例えば高さが５～１００ｎｍ、直径が１～２０μｍ、間隔が１～１００μｍの範囲である。

【００５３】次に、上記のようにして得られたガラス基板等の基板１１の表面に、例えばスパッタリングによって下地層、磁性層、保護層等が順に形成され、磁気記録媒体が作製される。具体的には、下地層としてはクロム（Ｃｒ）－モリブデン（Ｍｏ）の層、磁性層としてはコバルト（Ｃｏ）－白金（Ｐｔ）－クロム（Ｃｒ）－タンタル（Ｔａ）の層、保護層としては炭素（Ｃ）の層等が挙げられる。さらに、その上に潤滑剤としてパーフルオロポリエーテル系のものによる潤滑層を形成してもよい。

【００５４】以上のような実施形態によれば、次のような効果が発揮される。

・　基板表面の平均面粗さＲａが０．４～３．０ｎｍであり、基板表面の平均面粗さ（Ｒａ）に対する基板表面の１０点平均面粗さ（Ｒｚ）の比が１４以下であり、かつベアリング・デプスによる基準値｛Ｚ（５０％）－Ｚ（１％）｝に対するＺ（１％）の比が３以下である微小凹凸を形成したことから、アスペリティのない微小凹凸を安定して形成することができるとともに、突起の高さをほぼ均一となるように揃えることができ、記録された情報を安定して読み取ることができる。

【００５５】・　基板１１を非磁性材料で形成したことにより、例えば基板１１に平行な面方向に磁化され、情報が記録される長手方向記録方式の磁気記録媒体の場合には、基板１１上に設けられた磁気層が基板１１からの磁気の影響を受けることによって生ずる自己減磁等といった不具合を解消することができる。

【００５６】・　基板１１を磁性材料で形成したことにより、例えば厚み方向に磁化され、情報が記録される垂直磁気記録方式の磁気記録媒体の場合には、下地膜等を省略して構成することができ、基板１１上に設けられる膜構成を簡素化し、膜厚を薄くすることができる。

【００５７】・　微小凹凸をデータ領域１４に設けたことにより、磁気ヘッド等が記録された情報を読み出すとき、ヘッド先端がデータ領域１４の表面に密着することを防止でき、情報の読み出しを安定して行うことができる。

【００５８】・　データ領域１４以外の領域にレーザ光の照射等の処理手段を施すことで新たな凹凸を形成することによって、例えばＣＳＳ方式の磁気記録媒体においては、スライダが安定して離着陸するための領域を形成することができ、ランプロード方式の磁気記録媒体においては、スライダ面に付着された微細なちり（コンタミ）等の異物をクリーニングするための領域を設けることができる。

【００５９】

【実施例】以下、実施例及び比較例を挙げ、前記実施形態をさらに具体的に説明する。なお、この発明はそれらの実施例に限定されるものではない。

（実施例１）化学強化された直径２．５インチのアルミノシリケートガラス基板材料の表面を精密研磨した後、純水を用いてスクラブ洗浄した。次いで、０．１重量％濃度で３５℃のフッ酸水溶液中にてスクラブエッチングしながら１．５分間浸漬した後に引き上げ、さらにｐＨ１２の水酸化カリウム溶液に２．５分間浸漬した後引き上げた。その後、再度純水を用いてスクラブ洗浄した。これを実施例１の試料とした。

（実施例２）直径２．５インチのアルミノシリケートガラス基板材料の表面を精密研磨し、その表面のＲａを０．３～０．６ｎｍとした後、純水を用いてスクラブ洗浄した。次に、０．１重量％で５０℃のフッ酸（ＨＦ）水溶液中に２．５分間、ガラス基板を揺動しながら浸漬した後、温純水でリンスして薬液を除去した。その後、ｐＨ１２に調整した水酸化カリウム水溶液中にて２．５分間揺動しながら浸漬洗浄し、その後、温純水、純水にてリンスして薬液を除去した。次にイソプロピルアルコールの浴に超音波を照射しながらガラス基板を浸漬洗浄し、最後にイソプロピルアルコール蒸気中で１分間乾燥させた。

【００６０】次にカリウムを含む溶液中にてイオン交換を行い化学強化処理を行った。その後、ガラス基板表面に付着した塩を水洗にて充分に洗浄した後、ｐＨ１１に調整した水酸化カリウム水溶液中にて３０秒間、超音波を照射しながら浸漬洗浄し、続いてスクラブ洗浄を行った。次に、再度ｐＨ１１に調整した水酸化カリウム水溶液中にて１６０秒間、超音波を照射しながら浸漬洗浄した。次いで、純水浴に浸漬してリンスする操作を数回繰り返し、次にイソプロピルアルコールの浴に超音波を照射しながらガラス基板を浸漬洗浄し、最後にイソプロピルアルコール蒸気中で１分間乾燥させた。これを実施例２の試料とした。

（実施例３）化学強化された直径２．５インチのアルミノシリケートガラス基板材料の表面を精密研磨した後、純水を用いてスクラブ洗浄した。次に、０．０３重量％で４０℃のフッ酸（ＨＦ）水溶液中に３０分間、ガラス基板を揺動しながら浸漬した後に引き上げ、さらにｐＨ１２に調整した水酸化カリウム水溶液中にて２．５分間浸漬した後引き上げた。その後、再度純水を用いてスクラブ洗浄した。これを実施例３の試料とした。

（実施例４）化学強化された直径２．５インチのアルミノシリケートガラス基板材料の表面を精密研磨した後、純水を用いてスクラブ洗浄した。次いで、０．１重量％濃度で５０℃のフッ酸水溶液中にて２．５分間、揺動しながら浸漬した後、純水にてリンスし、さらに０．０１重量％濃度で２７℃のフッ酸水溶液中にて３０分間、揺

動しながら浸漬した後、引き上げ、さらにｐＨ１２の水酸化カリウム溶液に２．５分間浸漬した後引き上げた。その後、再度純水を用いてスクラブ洗浄した。これを実施例４の試料とした。

（比較例１）化学強化された直径２．５インチのアルミノシリケートガラス基板材料の表面を精密研磨した後、純水を用いてスクラブ洗浄した。次に、０．０１重量％のフッ酸（ＨＦ）水溶液中に１０分間、ガラス基板を揺動しながら浸漬した後に引き上げ、さらにｐＨ１２に調整した水酸化カリウム水溶液中にて２．５分間浸漬した後引き上げた。その後、再度純水を用いてスクラブ洗浄した。これを比較例１の試料とした。

（比較例２）直径２．５インチのアルミノシリケートガラス基板材料の表面を精密研磨した後、純水を用いてスクラブ洗浄した。次に、０．００５重量％で４０℃のフッ酸（ＨＦ）水溶液中に３０分間、ガラス基板を揺動しながら浸漬した後に引き上げ、さらにｐＨ１３に調整し＊

＊た水酸化カリウム水溶液中にて２．５分間浸漬した後引き上げた。その後、再度純水を用いてスクラブ洗浄した。これを比較例２の試料とした。

（微小凹凸形状の評価）上記実施例１～４及び比較例１～２を、走査プローブ型顕微鏡（デジタル・インスツルメント社製、ナノスコープIII ）にて１０μｍ×１０μｍの視野で観察し、平均面粗さＲａ、１０点平均面粗さを平均面粗さで割った値であるアスペリティレシオ（Ｒｚ／Ｒａ）及びベアリング・デプスの比で定義したアスペリティレシオ（Ｚ（１％）／｛Ｚ（５０％）－Ｚ（１％）｝）を求め、表１にまとめた。なお、測定した全てのサンプルの微小凹凸は等方的かつ凹部又は突起の間に実質的に平坦な部分を有さない連続的な凹凸形状を有していた。

【００６１】

【表１】

	平均面粗さ Ra(nm)	アスペリティレシオ Rz／Ra	アスペリティレシオ Z(1%)／{Z(50%)－Z(1%)}
実施例1	1.0	10.0	1.1
実施例2	1.1	12.0	1.4
実施例3	1.0	13.8	2.4
実施例4	0.9	12.3	2.8
比較例1	1.0	32.0	9.5
比較例2	1.0	17.7	1.9

表１に示したように、実施例１及び２ではいずれもＲａ値が１．０前後と小さく、かつアスペリティレシオ（Ｒｚ／Ｒａ）及びアスペリティレシオ（Ｚ（１％）／｛Ｚ（５０％）－Ｚ（１％）｝）が小さなガラス基板を作製することができた。実施例３ではＲａ値は１．０と小さいが、Ｒｚ／Ｒａが１３．８と実施例１及び２と比較して若干高めであった。加えて、Ｚ（１％）／｛Ｚ（５０％）－Ｚ（１％）｝が２．４であり実施例１及び２と比較して若干高めであった。実施例４ではＲａ値が０．９で小さな値であり、Ｒｚ／Ｒａが１２．３と小さなガラス基板を作製することができた。しかし、Ｒｚ／Ｒａが実施例３より小さな値であるにもかかわらず、Ｚ（１％）／｛Ｚ（５０％）－Ｚ（１％）｝が２．８であり、実施例３と比較して大きな値となった。

【００６２】これに対し、比較例１ではＲａ値は小さいが、Ｒｚ／Ｒａが３２．０であり、Ｚ（１％）／｛Ｚ（５０％）－Ｚ（１％）｝が９．５であり、実施例１～４と比較してかなり大きくなった。比較例２では比較例１と同様にＲａ値は小さいが、Ｒｚ／Ｒａが１７．７であり、比較例１よりはかなり小さな値ではあるが、実施例１～４よりも高い値を示した。しかし、Ｚ（１％）／｛Ｚ（５０％）－Ｚ（１％）｝が１．９であり、実施例３及び４よりも低い値を示した。

【００６３】また、比較例１及び２では原子間力顕微鏡（ＡＦＭ）の鳥瞰図からも明らかにアスペリティが離散的に存在しているのが確認された。以上の結果より、Ｒａが０．４～１．０ｎｍの範囲であり、Ｒｚ／Ｒａが１２以下であり、かつＺ（１％）／｛Ｚ（５０％）－Ｚ（１％）｝が２以下であることがより好ましいことが示された。

【００６４】そして、Ｒｚ／Ｒａのみでアスペリティを評価した場合、突起の高さのばらつきを評価することができず、逆にＺ（１％）／｛Ｚ（５０％）－Ｚ（１％）｝のみでアスペリティを評価した場合、離散的に存在するアスペリティを評価することができないため、この２つを指標としてアスペリティを評価することが有効であることと考えられる。

（磁気記録媒体の微小凹凸形状の評価）実施例１、比較例１及び比較例２で得られた基板の表面に、スパッタリングによって順次チタン（Ｔｉ）－ケイ素（Ｓｉ）シード層（２５ｎｍ）、クロム（Ｃｒ）－モリブデン（Ｍｏ）下地層（２５ｎｍ）、コバルト（Ｃｏ）－ニッケル（Ｎｉ）－クロム（Ｃｒ）－タンタル（Ｔａ）磁性層（２０ｎｍ）、炭素（Ｃ）保護層（１０ｎｍ）を形成し

た。その後、潤滑剤としてパーフルオロポリエーテル系のものを塗布して潤滑層（２ｎｍ）を形成し、磁気記録媒体とした。

【００６５】上記実施例１、比較例１及び比較例２のガラス基板から形成した磁気記録媒体をガラス基板における微小凹凸形状の評価と同様の方法で観察し、平均面粗さＲａ、１０点平均面粗さを平均面粗さで割った値であ＊＊るアスペリティレシオ（Ｒｚ／Ｒａ）を求め、表２にまとめた。なお、測定した全てのサンプルの微小凹凸は等方的かつ凹部又は突起の間に実質的に平坦な部分を有さない連続的な凹凸形状を有していた。

【００６６】

【表２】

	ガラス基板		磁気記録媒体	
	平均面粗さRa(nm)	アスペリティレシオRz／Ra	平均面粗さRa(nm)	アスペリティレシオRz／Ra
実施例1	1.0	10.0	1.0	10.0
比較例1	1.0	32.0	1.0	30.0
比較例2	1.0	17.7	1.0	17.7

表２に示したように、実施例１、比較例１及び比較例２において、基板表面に形成したアスペリティを含む微小凹凸はほとんどそのまま潤滑層表面まで残ることが確認された。

（磁気記録媒体の評価）上記のようにして得られた磁気記録媒体をランプロード方式のハードディスク装置のスピンドルに装着し、３６００ｒｐｍで回転させ、またＡＥセンサ付きの磁気ヘッドを浮上させたままでシーク動作を行い、ＡＥセンサの出力をモニターした。

【００６７】実施例１の磁気記録媒体においては、シーク動作を行っても磁気ヘッドと磁気ディスクとが衝突したことを示すＡＥセンサの出力は認められず、磁気ヘッドのグライドエラーもなかった。また、フライングハイトを１５ｎｍに設定してグライドテストを行ったところ、グライドヒットは生じなかった。さらに、１０万回のシーク動作を繰り返したが、ヘッドクラッシュは生じなかった。

【００６８】比較例１の磁気記録媒体においては、シーク動作を行うとＡＥセンサの出力が認められた。また、１０万回のシーク動作を繰り返した場合、途中でヘッドクラッシュが生じた。比較例２の磁気記録媒体においても比較例１と同様にＡＥセンサの出力が認めら、１０万回のシーク動作の結果、途中でヘッドクラッシュが生じた。

【００６９】なお、本実施形態は、次のように変更して具体化することも可能である。

・　データ領域１４を含む基板１１の表面の全面に、Ｒａが０．４～３．０ｎｍの範囲であり、Ｒｚ／Ｒａが１４以下であり、かつＺ（１％）／｛Ｚ（５０％）－Ｚ（１％）｝が３以下である微小凹凸を形成してもよい。

【００７０】このように構成した場合、データ領域１４以外の領域においても、アスペリティの発生を抑制した微小凹凸を形成することができる。

・　微小凹凸はスクラブエッチング処理により形成されるものに限定されず、浸漬処理により形成してもよい。

【００７１】このように、所定の条件下での浸漬処理によっても微小凹凸を形成することができる。さらに、前記実施形態より把握される技術的思想について以下に記載する。

【００７２】・　基板表面の平均面粗さ（Ｒａ）が０．４～１．０ｎｍの範囲であり、基板表面の平均面粗さ（Ｒａ）に対する基板表面の１０点平均面粗さ（Ｒｚ）の比が１２以下であり、基準値｛Ｚ（５０％）－Ｚ（１％）｝に対するＺ（１％）の比が２以下である微小凹凸を基板の表面に形成した請求項１から請求項４のいずれかに記載の磁気記録媒体用基板。

【００７３】このように構成した場合、基板表面に形成される微小凹凸の形状や粗さをさらに好適なものとすることができる。・　前記基板はガラス基板であり、微細な凹凸をスクラブエッチングにより形成することを特徴とする請求項２又は請求項４に記載の磁気記録媒体用基板。

【００７４】このように構成した場合、基板表面に形成される微小凹凸の形状や粗さを好適に制御することができる。

【００７５】

【発明の効果】以上詳述したように、この発明によれば、次のような効果を奏する。請求項１に記載の発明の磁気記録媒体用基板によれば、アスペリティのない微小凹凸を安定して形成することができるとともに、突起の高さをほぼ均一となるように揃えることができ、記録された情報を安定して読み取ることができる。

【００７６】請求項２に記載の発明の磁気記録媒体用基板によれば、請求項１に記載の発明の効果に加えて、基板上に設けられる磁気層を安定して形成することができる。請求項３に記載の発明の磁気記録媒体用基板によれば、請求項１に記載の発明の効果に加えて、例えば垂直磁気記録方式の磁気記録媒体であれば、下地膜等を省略することができるため、基板上に設けられる膜構成を簡素化し、膜厚を薄くすることができる。

【００７７】請求項４に記載の発明の磁気記録媒体用基板によれば、請求項１から請求項３のいずれかに記載の

発明の効果に加えて、記録される情報をより安定して読み出すことができる。

【図面の簡単な説明】

【図１】　（ａ）は微小凹凸の粗さが粗い状態の基板表面を示す概念図、（ｂ）は微小凹凸の高さがばらついた状態の基板表面を示す概念図。

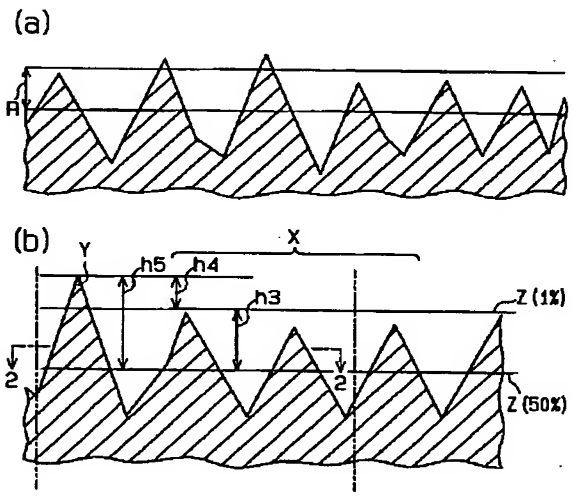
＊【図２】　図１（ｂ）の２－２線における断面図。

【図３】　磁気記録媒体を示す平面図。

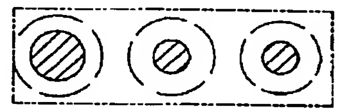
【符号の説明】

１０…磁気記録媒体用基板、１１…基板、１４…データ領域。

【図１】



【図２】



【図３】